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Iron and Steel ENGINEER

VOL. XIV JUNE • 1937 NO. VI

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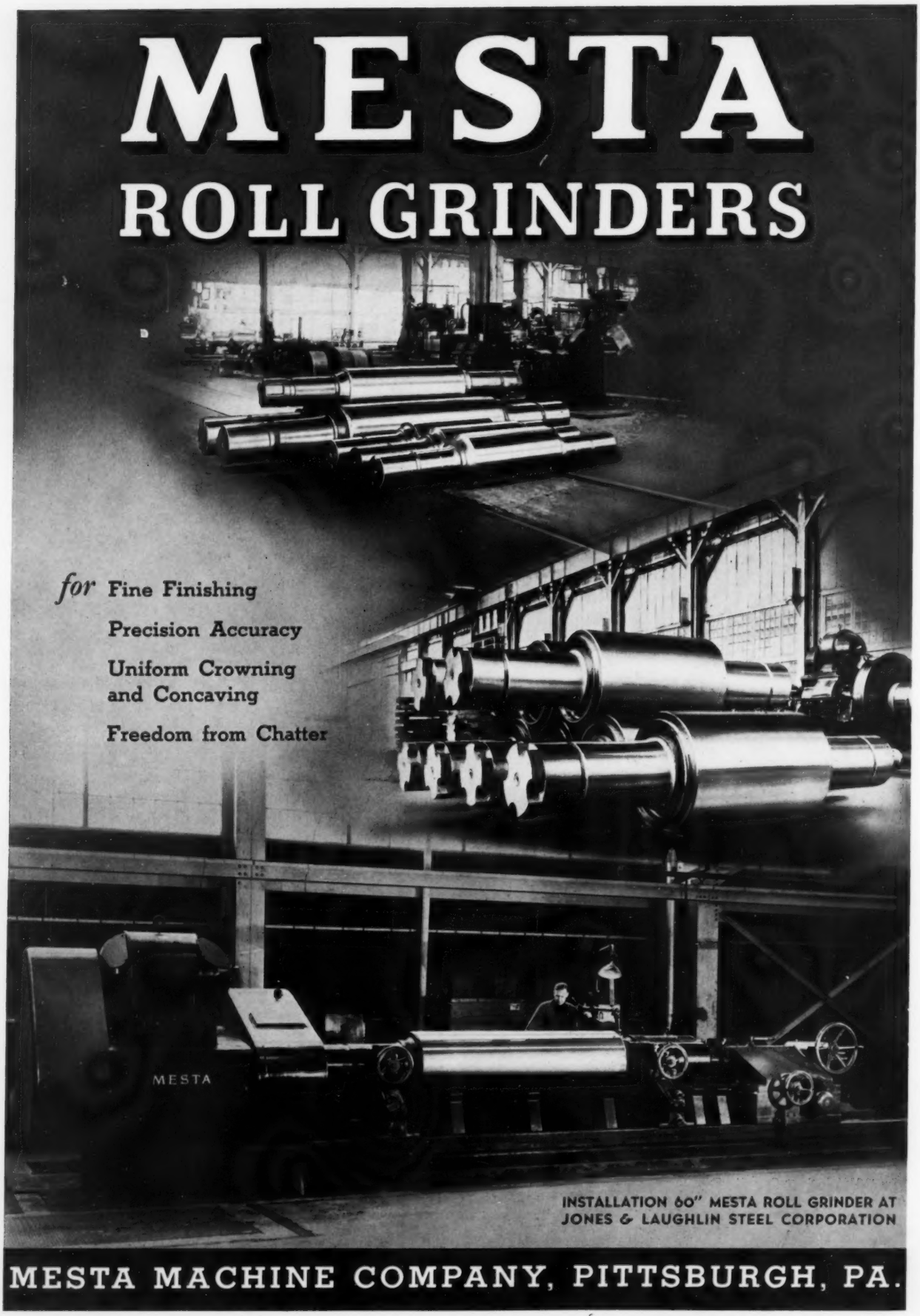

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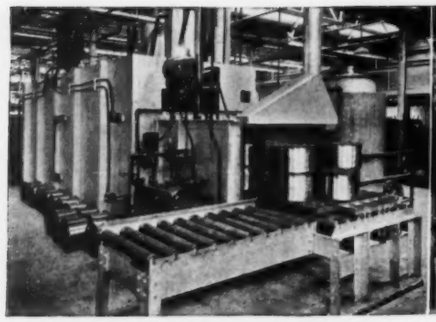

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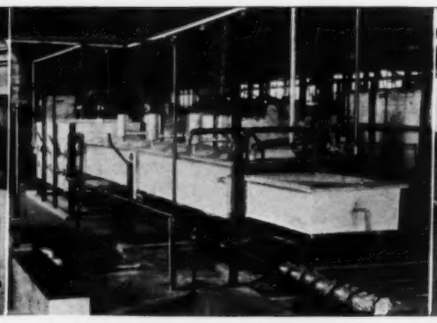

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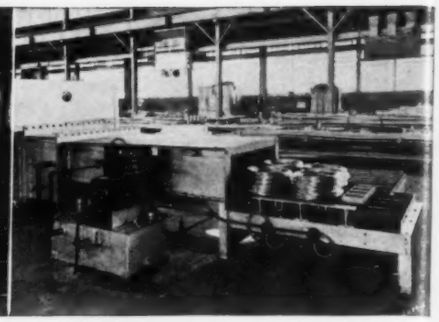

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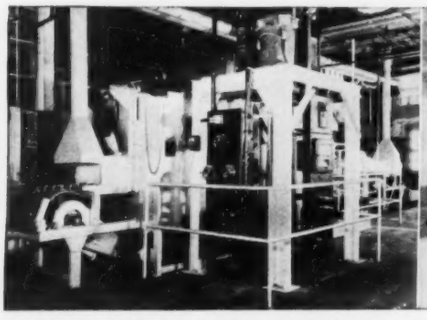
—in coils



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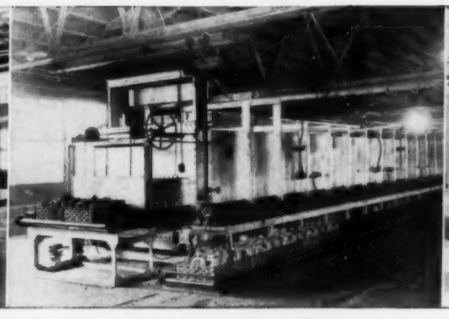

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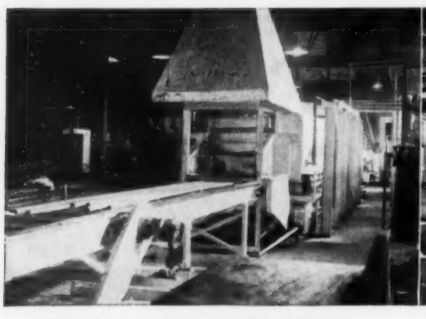
SCALE FREE HARDENING BOLTS
—in chain belt furnaces



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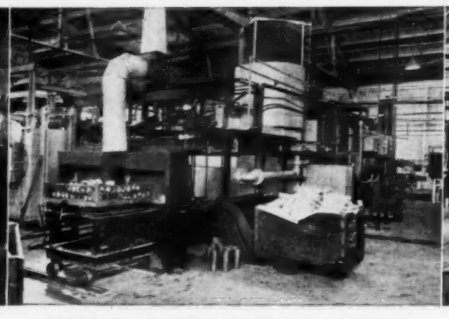

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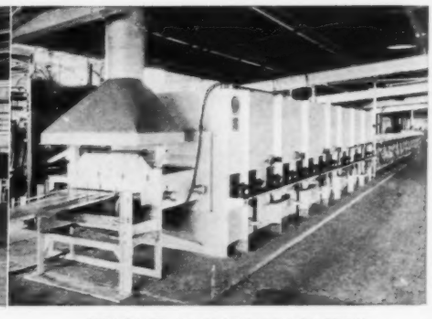

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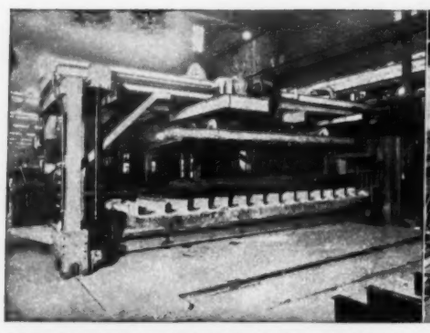

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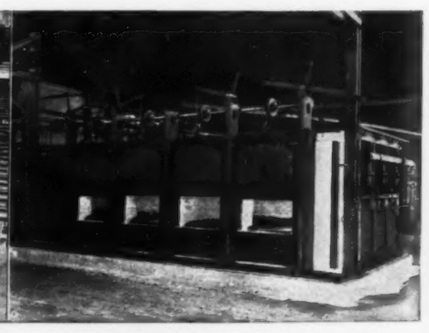

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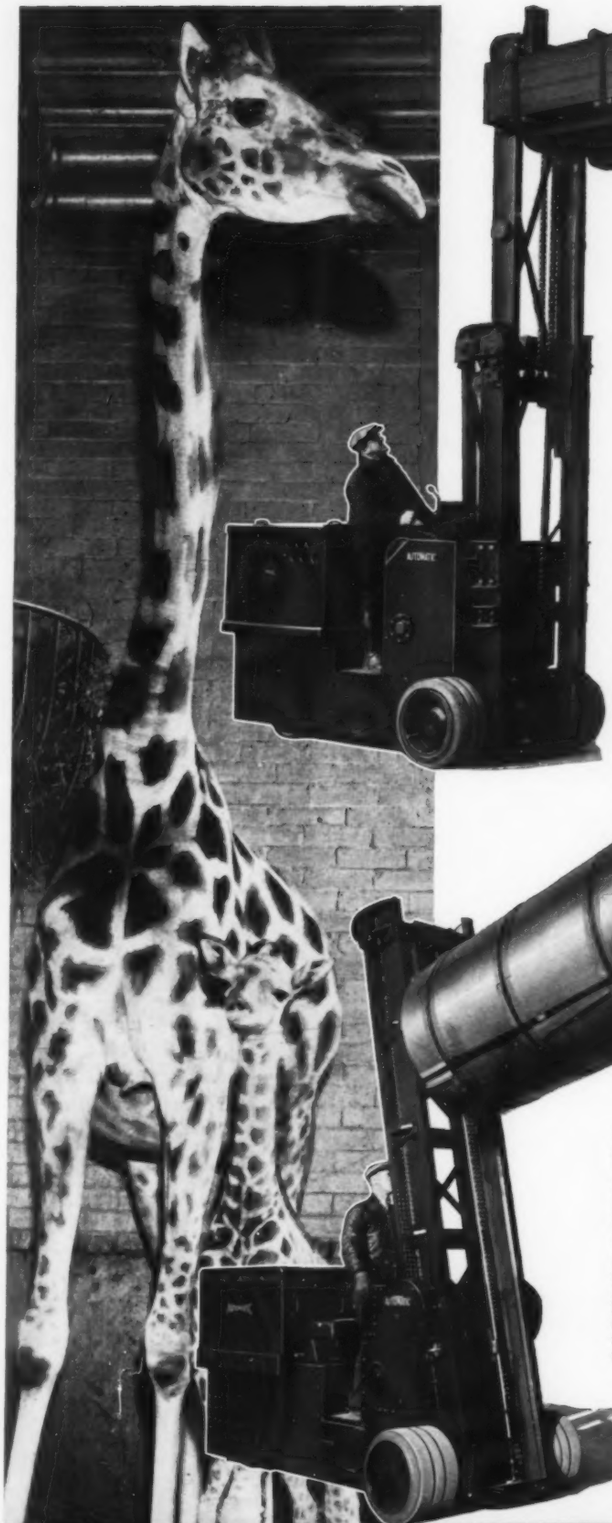

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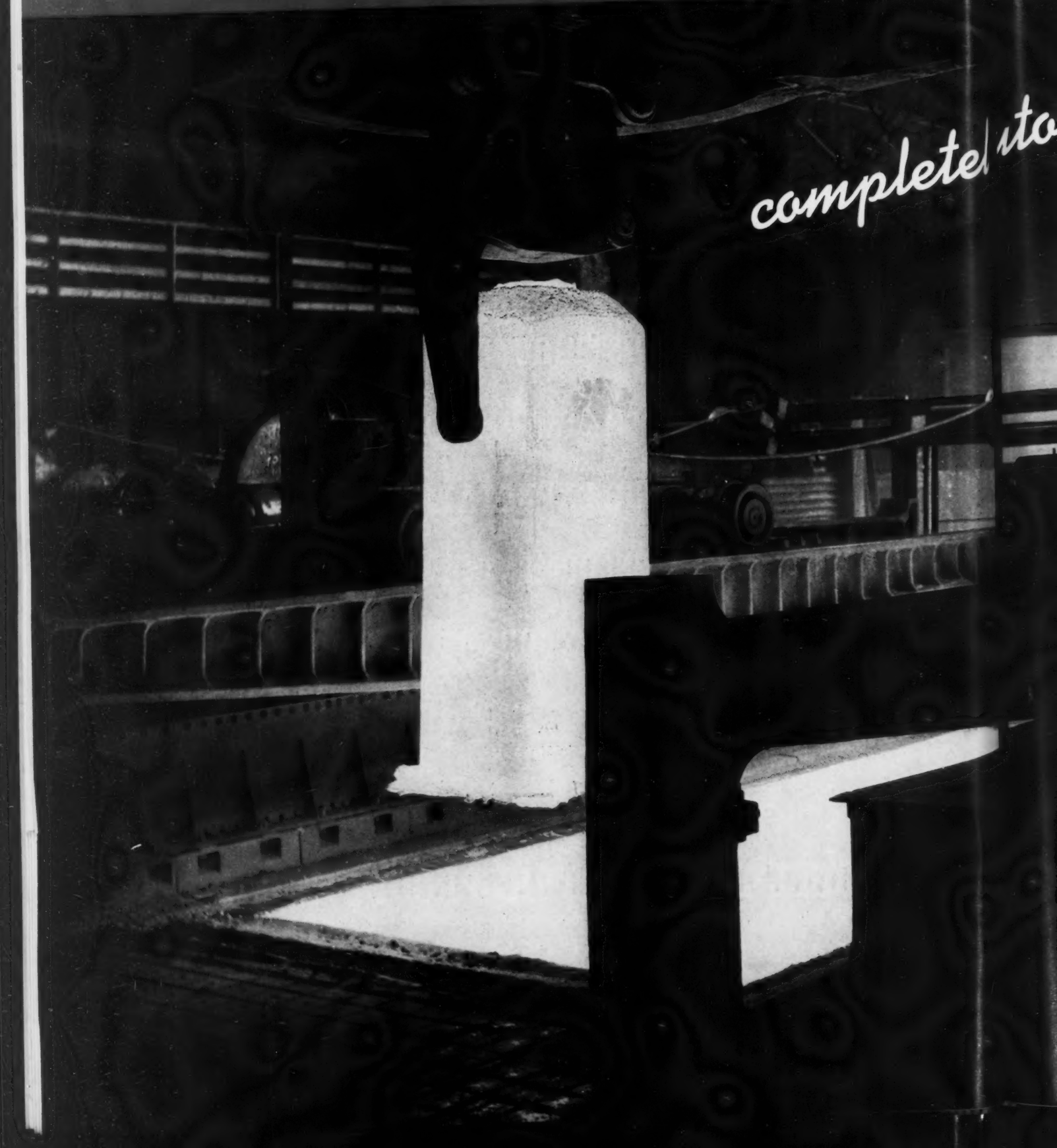

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● Brought up to date – to meet current and future demands for volume production – the SC One-Way Fired soaking pit is now available to steel producers with all of its old advantages intact – and many exclusive new ones essential to production speed and economy.

Combustion, pressure and temperature control on a fully automatic scale has been carefully engineered into Surface Combustion soaking pit design – is an integral part of the installation. Standard control systems are used, large scale instruments mounted on a control panel, one for each pit hole. Pyrometer couples are installed in pits opposite burners, indicating and recording the temperature of the ingot through a radiation tube projecting into the wall of the pit. With the horse-shoe flame travel used, absolute uniformity of heat in the new SC soaking pit is automatically maintained. Firing port and outlet flue are installed in the same end of the one-way pit, and much heavier construction is thereby possible.

With uniformity of heating and accurate temperature control, scale losses are controlled with greater accuracy. Illustrated is one of a battery of five new SC one-way fired soaking pits showing one of the new-type sand seal covers of the vertical rising type in action. Not only do the new-type covers have positive heat retaining and atmosphere control advantages but their maintenance cost is far less than on the older-type covers.

Double the capacity of ingot storage in the same floor space has long been an advantage of SC construction – an advantage appreciated by every large steel producer today who is finding the "bottle-neck" of production in the soaking pits.

Typical conversion layouts for changing over regenerative pits to the modern SC One-Way Fired soaking pits will be sent on request. Designs include conversions for use of coke-oven gas, producer gas, blast furnace gas, natural gas, oil or combinations of these fuels.

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Thirty-Third ANNUAL CONVENTION and IRON & STEEL EXPOSITION

A. I. & S. E.

HOTEL STEVENS, CHICAGO, ILL. -- SEPT. 28, 29, 30 -- OCT. 1, 193

Herewith is presented a partial list of subjects to be discussed at the technical sessions:

1. Manufacture and Use of Rolls.
2. Electric Cables in the Steel Industry.
3. Development in the Rolling of Flat Steel Products.
4. Blast Furnace Design and Practice.
5. D. C. Drive for Mill Runout Tables and Coilers.
6. Protective Atmospheres for Annealing Furnaces in Steel Mills.
7. Latest Development of Alternating Current Welding.
8. Complete Control of Recuperative and Regenerative Soaking Pits.
9. Use of E. P. Lubricants in the Steel Industry.
10. Circulating Oil Systems.
11. Load Factor on the Low Voltage D. C., A. C. Systems in Steel Plants.
12. Application of Carbon to Pickling Tanks.
13. Welding Economics and Application.
14. Design and Operation of New Boiler House.
15. Modern Steam Power Developments.

View of Cold mill, Carnegie-Illinois Steel Corp., Gary, Ind., to be shown members and guests on Wednesday, September 29, 1937.

View of 76" mill, Inland Steel Company to be inspected by the Association, Friday morning, October 1, 1937.

ADVERTISING PAGES REMOVED

SOAKING PIT FURNACE

New Design and Operation

By P. M. OFFIL, Vice President
Amsler-Morton Company
PITTSBURGH, PA.

Presented before the Annual Convention of the A. I. & S. E., Detroit, Michigan, Sept. 22-25, 1936

▲ THE correct principle for the application of heat to the pit furnace may be derived from the continuous furnace, open hearth, and other types of successful steel furnaces, in which the flow of the heated gases of combustion is parallel with the principal axis of the steel. Soaking pits have long offended the fundamental principles which govern heat transfer by radiation and convection. This has now been proved by the operation of the AMCO Pit in which the principle is carried out in a new form of furnace, by directing the fuel along the long axis of all ingots simultaneously and equidistant thereto.

P. M. OFFILL

This pit is believed to be the first design to properly utilize a rational heating method. This is made possible by firing the pit through a port located in the center of the hearth, and by arranging the ingots on the usual hearth to surround the port, thus avoiding direct impingement of the flame on the ingots, and at the same time introducing the fuel at a very low pressure which develops into a vertically moving column of burning fuel of substantial cross-section. Lower flame temperatures are used in this pit than in conventional pits, and high rates of heating obtained without washing the ingots.

This method of firing is 100% continuous through the heating and soaking cycle. Inter-cyclic adjustments of burners and controls is eliminated, i. e., there are no alternating periods of firing and soaking. The ingots surround the port, and are not directly in the path of the flame. The waste gas outlets are arranged at the four corners of the hole near the bottom to remove the waste heat which is carried "fountain like" entirely around the ingots. As flame enters the combustion chamber through a firing port in the center of the hearth it contracts materially due to acceleration of velocity by the rising free convection current as it leaves the port. This acceleration increases turbulence, which is very desirable for proper circulation of heat produced, and, also, to recirculate, by induction, a portion of the relatively cooler gases within the furnace. This keeps the cooler gases from lying stagnant on the hearth. This develops an unusually uniform heating, never previously realized in a pit furnace.

The natural movement of convection currents in a furnace of the hearth port type tends to equally distribute the heat, and it produces a degree of uniformity not only unequalled, but virtually impossible of realization with other methods. A plural hole furnace does not have equal radiation losses. In this new pit, heat is distributed by regulating its flow to suitable damper controlled outlets to balance the radiation losses, which are varied by the location of the pit. Each pit and recuperator has an independent fuel and air supply system. This is of great importance, and has quick repair advantages which are not available to the furnace depending upon a single heat exchanger or set of controls. The central undirectional firing port eliminates the stratified air and gas streams which occur in regenerative furnaces. The simplicity of the fuel application to the pit is valuable in that it is considerably easier to control a single burner, with uninterrupted cycle, automatically, than a series of intermittently fired units.

The walls of the pit are cambered to provide for shrinkage, and definitely control the forces which would tend to deform the walls. This avoids all distortion

common to long furnace walls subjected to high temperatures, and further stablizes the position of the furnace seal relative to the cover.

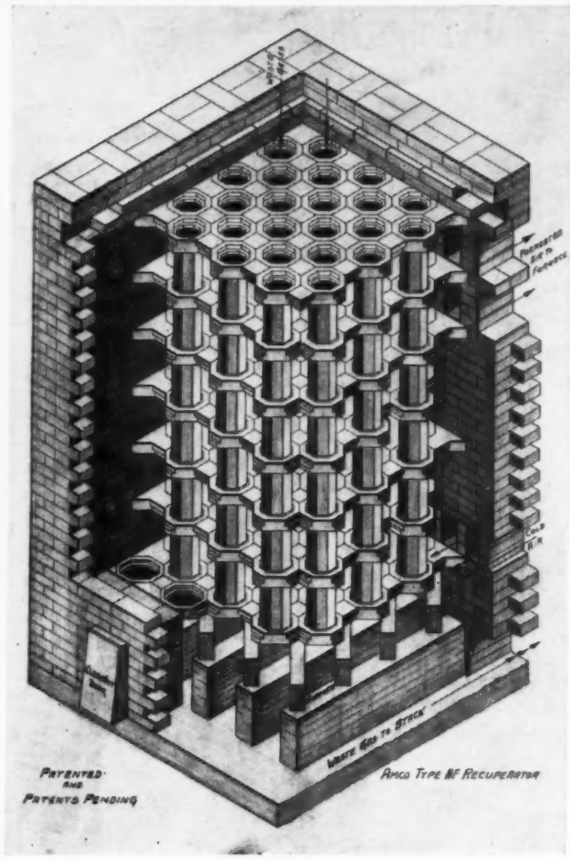
The pit depth is not increased over common regenerative practice. Bottom making is accomplished solely by a modern stiff legged crane, equipped with a special tool, and, it is now necessary to make bottom but twice a month. This effects a saving of about sixty hours of labor per week, when compared with equal capacity of regenerative pits. In addition, this effects an increase in Bessemer practice of one extra heat per day, and saves considerable coke.

The method of firing controls the character and thickness of scale. Operations of this type to date have shown 180 pounds of iron per week in the cinder removed from the pit as against 2700 pounds of iron per week in cinder heated in regenerative pits. The slag, or cinder, is loose, as a result of carrying approximately but 20% of iron, and may be readily removed mechanically; ordinarily, slag is tenacious and carries about 60% iron, and requires manual labor for removal when cleaning.

The fuel consumption has averaged 180,000 B.T.U. per gross ton monthly overall on all hot Bessemer steel, and less than 1,400,000 B.T.U. per gross ton on cold Bessemer or O. H. steel. The fuel rate per ton hour of heating time is about 110,000 B.T.U.

Heating cycles for hot steel are about 2 hours and cold steel about 7½ hours. It has been established, however, that the time required depends upon the heat lost from the steel between teeming and charging.

Washing of ingots is entirely eliminated due to cor-



View of section through air flow recuperator.

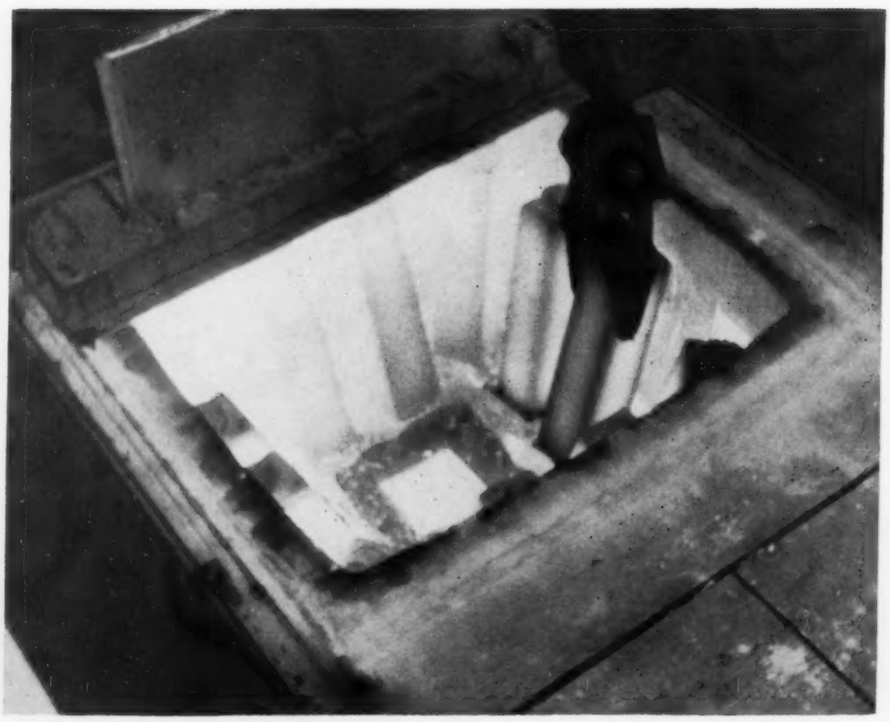


Illustration of an ingot being placed in the soaking pit furnace.

rect fuel application and the use of a complete complement of dependable automatic combustion and temperature control. The combustion chamber in the pit is sand sealed and always under positive pressure. This eliminates infiltration of air, loss of heat and maintains a constant regulated furnace atmosphere, without manual attention.

AUTOMATIC TEMPERATURE, PRESSURE, AND COMBUSTION CONTROL

The pit is equipped with the most modern and simplified automatic control equipment, consisting of:

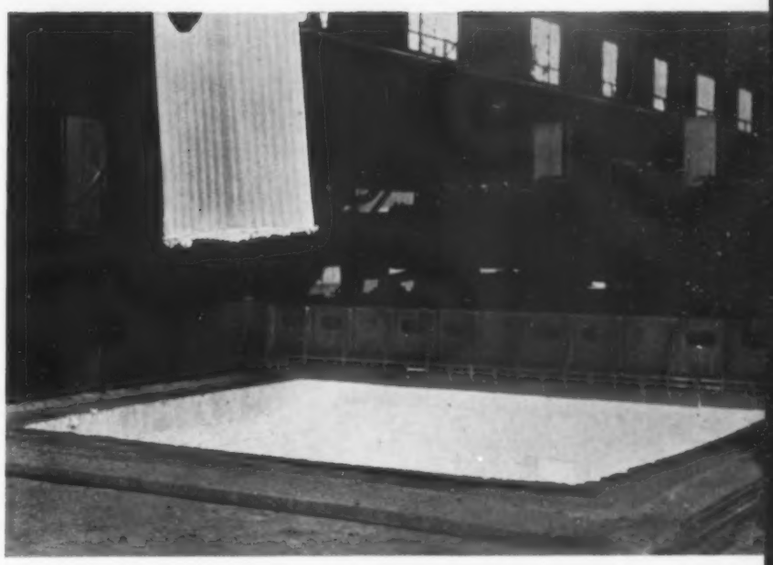
Temperature Control
Combustion Control (Air Gas Ratio)
Furnace Pressure Control
Fuel, air, and draft shut-off on cover opening.
Fuel, air, and draft shut-off on cover opening
Automatic Heating Cycle
Automatic Varying Pit Pressure
Automatic Varying Initial Fuel rate
Automatic B.T.U. Correction.

To the best of our knowledge, this is the first complete and thoroughly dependable application of automatic control equipment to the soaking pit furnace. The control system can be instantly adjusted for various ingot conditions and heating rates, to predetermine consistent uniform results for successive heats, whether on hot or cold alloy or low carbon steel.

RECUPERATOR

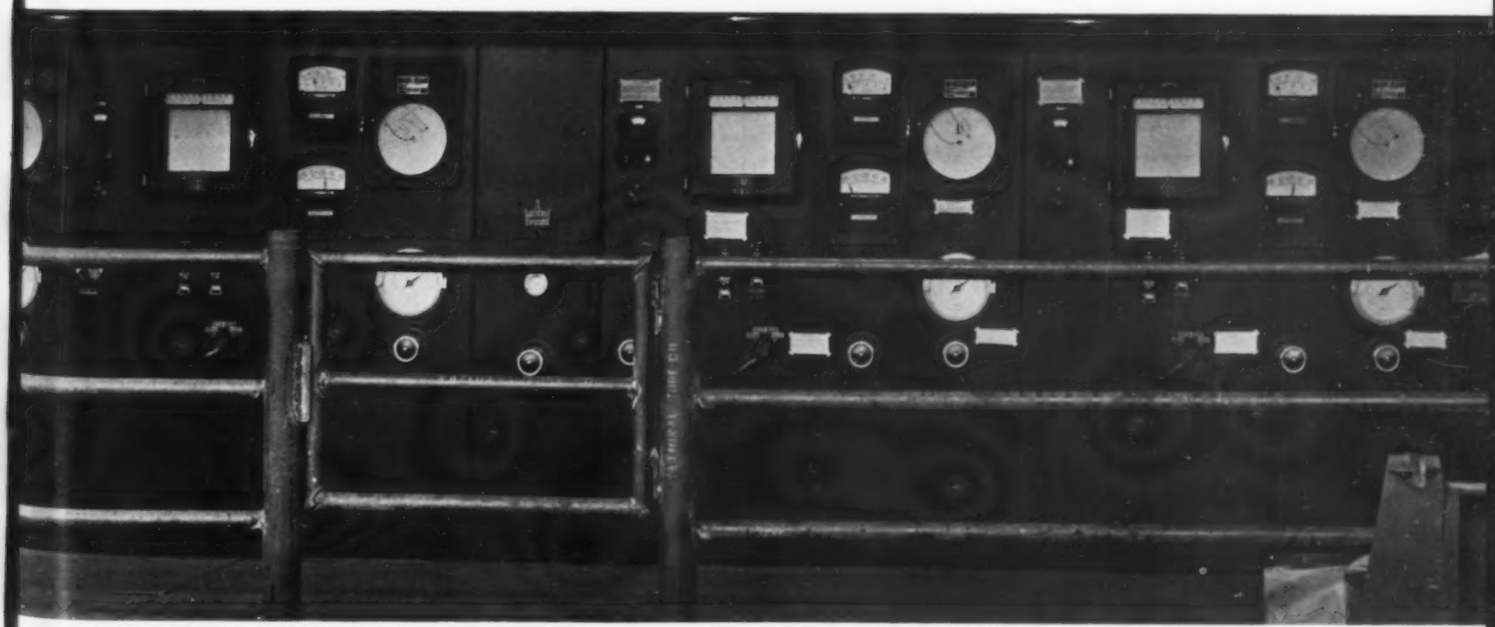
The recuperator of Amco design used with the pit has been constantly improved during a period of fifteen years on many furnaces of different types and in its present form is protected by patents of recent issue. It is an ideal embodiment of the continuous heat exchanger for high temperature furnace practice. The recuperator, while an integral part of the pit, may be dispensed with, but direct firing is not recommended.

A Neilsen Survey has been made to show the comparative efficiency of a melting furnace using this recuperator and a modern regenerative furnace for the same purpose. The summary of this survey shows reduced operating costs of over 30% in favor of the recuperative furnace. This saving has been exceeded in the Amco pit furnace practice.



View showing hot 25" x 25" ingot being removed from pit.

Type of control panel used for four pits.



The development of the recuperator into a vertical type instead of the common horizontal pass type was a recent change, and has produced very dependable service. It is satisfactory for the regular service required for melting operations and may be obtained in a wide variety of materials to meet different conditions. In the design of this recuperator, four features have been considered, each of paramount importance to the successful recuperator.

1. The waste gases enter all the flues simultaneously and are equally distributed from a superimposed distributing chamber or flue. As a result, the initial shock of the entire waste gas flow is counter-cooled by the air being preheated.
2. The recuperator is independently lined within a rectangular brick chamber like a checker setting. All the waste gases and air remain, and are moved, within the body of the recuperator tile. This insures higher preheat temperatures and more effective use of space.
3. The recuperator is constructed of hollow tile flue units spaced to insure uniform heating and counter-cooling. This feature eliminates unequal heating, and thereby prevents internal stresses in refractories. All joints in the Amco tile setting are horizontal and, in addition to the use of modern air setting cements, are sealed by the weight of the tile assembly to prevent leakage. Prudent selection of practical velocities and pressure for air and waste gas within the recuperator avoids leakage. The efficient design of the recuperator is shown by the fact that only 9.7 pounds of refractory material is required per square foot of heating surface.
4. Recuperators of ample size are recommended for each installation. The physical stability of tile units depends to a greater extent than is commonly recognized on the selection of the correct size of recuperator and thickness of tile to maintain permissable temperature differentials throughout the chamber.

Waste gases may be passed through the usual fire clay recuperators associated with the pit, and then through a metallic preheater to heat the blast furnace gas with the subsequent waste heat for delivery to the firing port of the pit. The use of tile of higher conductivity may be employed to dispense with gas preheaters by elevating the air preheat to about 1800° F. At present the average preheated air temperature of an Amco recuperator applied to a battery of pits, burning a high B.T.U. fuel is 1625° Fahr.

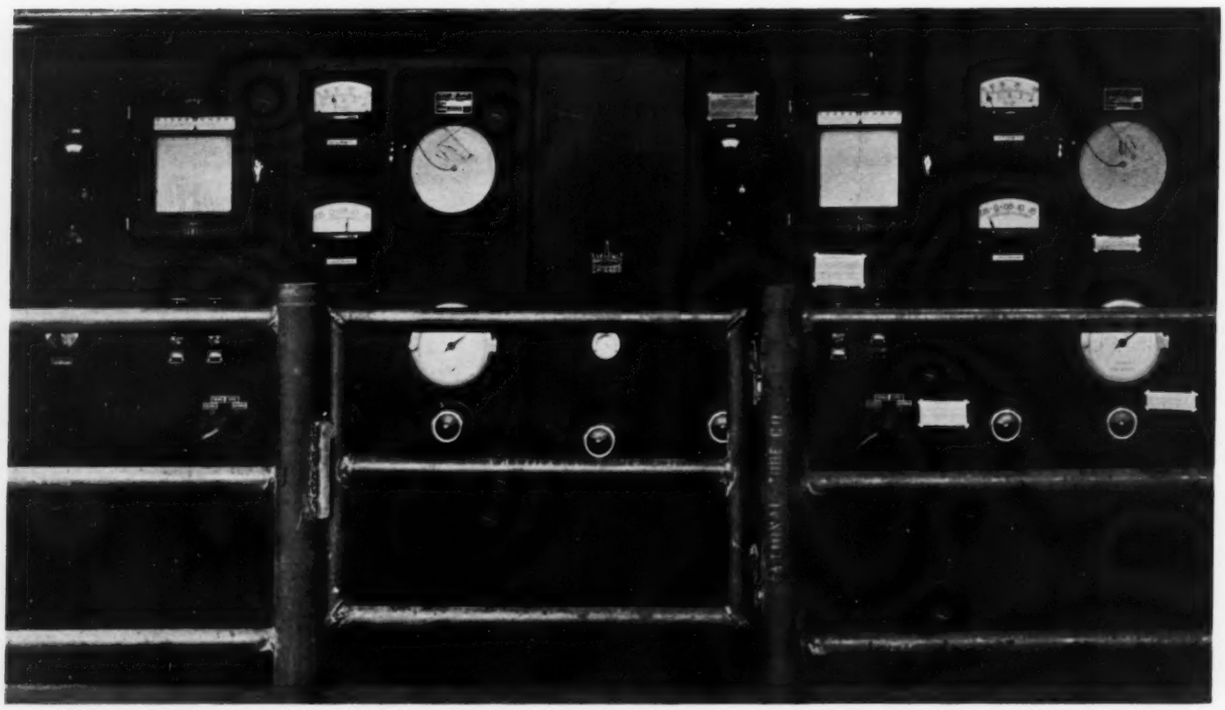
SINGLE FIRING PORT

Due to the position of the steel surrounding the firing port in the middle of the hearth, a lower flame tempearature than is normally required in the conventional pit furnace. Naturally, maintenance will be lowered. The release of the initial products of combustion between walls formed by the ingots, accounts in part for the exceptional fuel economy which averages about 10¢ per ton of steel.

VERTICAL LIFT PIT COVER TRAVERSE CARRIAGE

The seal type pit cover, in combination with the lift type traverse carriage in its present practical form,

Close-up view of panel for two-pits.



was pioneered by The Amsler-Morton Company. The cover is a flat suspended arch construction with alloy steel plates around the four sides which, when the cover is in lowered position, engages a granular refractory filled seal trough, forming a part of the pit curb walls.

This carriage is so designed that the mechanism will lift the cover directly vertical out of the seal trough before traversing. It is in its simplest and most practical form when constructed with two motors: One motor for hoisting and one for traversing. A single carriage may be constructed to handle the covers of several different pits to best suit the conditions of a particular soaking pit layout as follows:

Lift and traverse fractional or full opening in either direction.

This arrangement requires the low rail type tracks with stub wheel or crane type carriage.

The carriages may also be constructed to handle multiple covers, which type may be operated by a man riding the carriage or from a remote station. In this arrangement, the cost of equipment for operating a number of carriages is greatly reduced as is also the maintenance, due to a reduced number of mechanical units. In other words the carriage may become a simple travelling crane.

COVER MOVEMENT CONTROLLS AIR AND FUEL

In all of these arrangements, the cover movements control and are synchronized with fuel, air and furnace pressure to avoid unnecessary heat losses and cold infiltration due to stack draft during charging and drawing. Fuel and air are cut off and the stack dampers automatically closed when cover starts to open. These fuel shut-off features were also pioneered by The Amsler-Morton Company. During cleaning they prevent flow of dust into the heat exchanger.

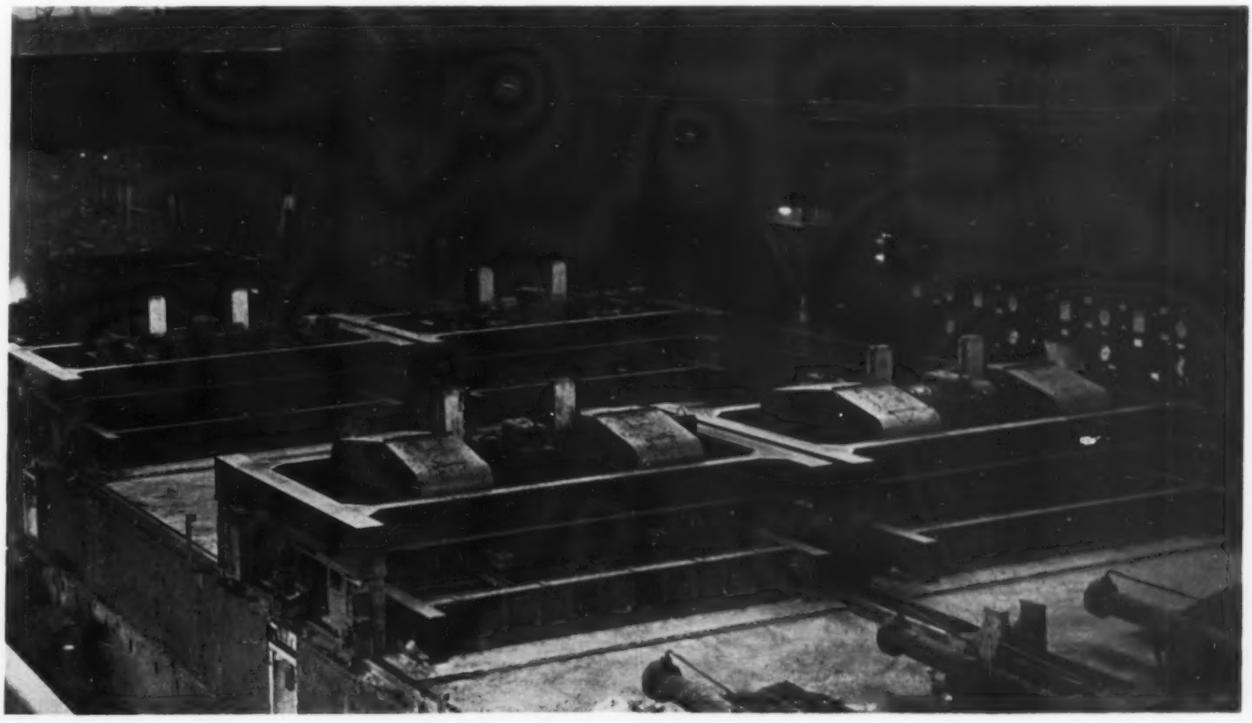
The absence of leaching of the ingot surface in the pit is of especial interest to sheet steel producers. The indicated reduction in losses from this cause appears to be not less than 50% when compared with conventional practice. This provides a quick amortization rate for the pit. The improvement in the surface of the ingot is due to the absence of incipient fusion which, at the temperatures required in pits in the ordinary practice, leaches certain inter-granular deposits from the ingot surface, increases the scale thickness, and alters the character of the scale. Scale from steel heated in the pit is loose and falls off readily on the mill table because it is smooth on both sides, leaving an undamaged ingot surface. It is obvious that uniform heating means the development of a uniformly fine granular body which insures quality steel.

In existing pit furnace buildings it is possible to increase ingot capacity up to 100% in the same floor space, and in new buildings, less floor space will be required.

The design and method of operating this pit is different from accepted practice. It incorporates every known means to effect economy, and avoids known but accepted evils. With such sweeping changes, new and hitherto unexpected results were anticipated, and, as the foregoing indicates, achieved, in a series of units which have operated for a sufficient time to prove that the pit is not only dependable, but a new asset with new and desirable characteristics.

Eighteen Amco pits with a setting capacity of 240 ingots will soon be in continuous service on virtually all fuels and types of steel.

Four 12′ 9″ x 12′ 9″ pits with seal type covers in place.



DEVELOPMENTS
in Steel Plant Distribution Systems

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Presented before the Philadelphia District Section A. I. & S. E., November 7, 1936.

▲IN discussing a subject as broad as this, it is always necessary to select what appear to be the points of most interest to the majority, and pass over others that may appeal even more to some of the readers. At best, a short paper can only touch the high spots of the subject and perhaps stimulate new thoughts regarding it.

The paper will cover some of the factors which determine the design of a distribution system, methods for evaluating these factors, some typical systems, and the modern switchgear equipment now available and being used.

Recent additions to steel mills have been limited almost exclusively to so-called continuous hot and cold strip mills, producing sheets and strip in varying widths up to 96". Although the type of mill does not greatly concern the distribution system, the amount of energy required and its concentration do affect the design, and the tremendous amounts of power demanded by the continuous mills necessitate great increases in system capacity.

The type of power supply for a plant will be one or the other of two schemes—power generated by the plant itself, or power purchased from an outside utility company. Of course, there will be variations of the two schemes and combinations of them. At present, there is some tendency toward the purchase of more

Figure 2—Single line diagram of a steel plant distribution system This is more or less typical of the arrangement for such a mill.

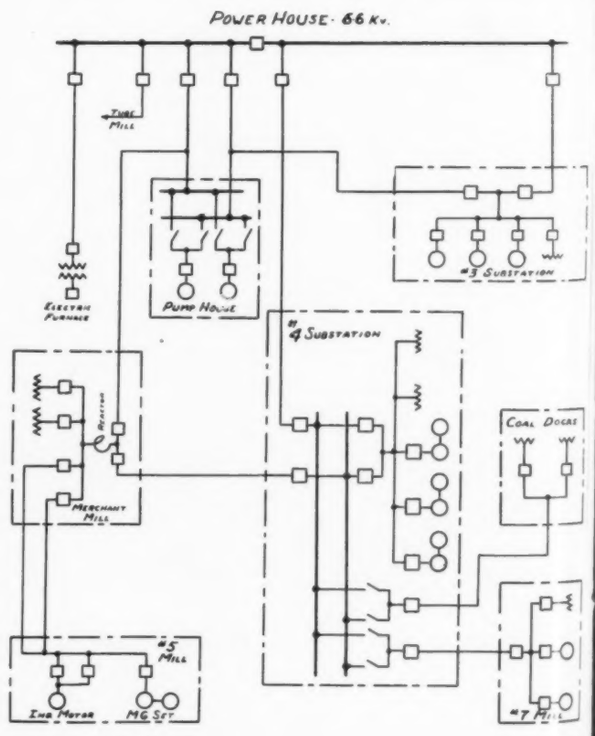
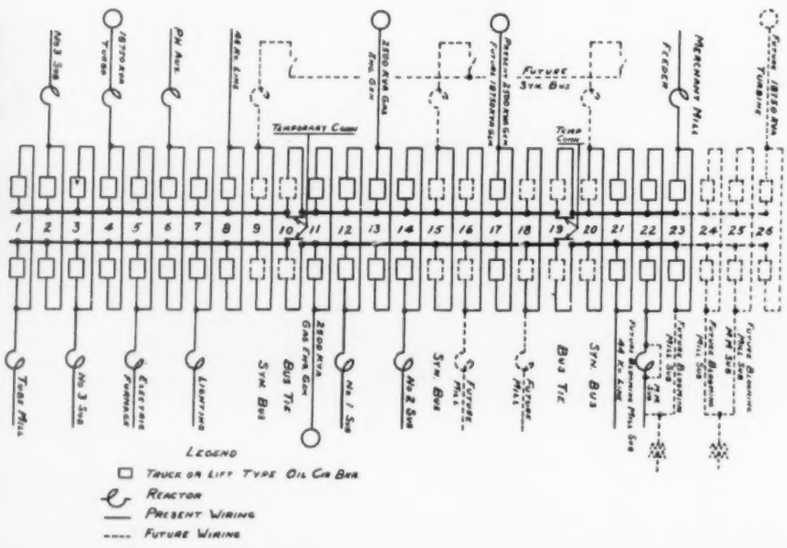


Figure 1—Diagram of a new installation to be made in one of the larger, more elaborate existing stations.



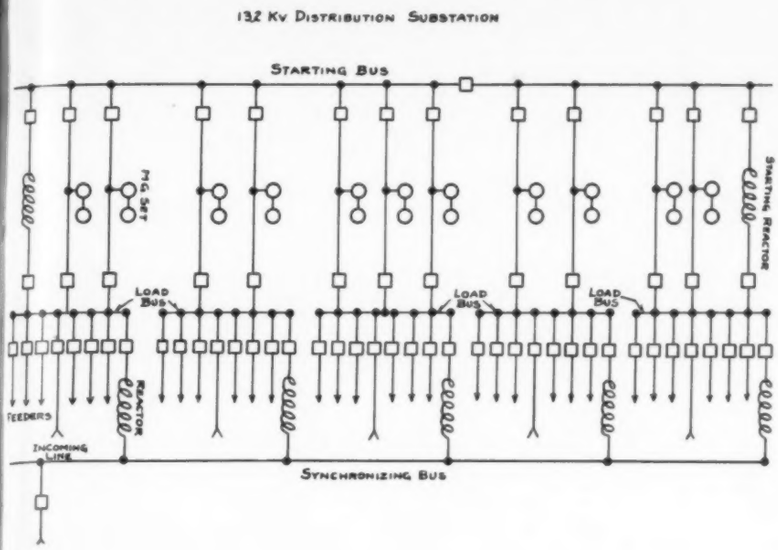


Figure 3—Diagram of sectionalized buses used at the Ford Motor Company hot strip mill sub-station.

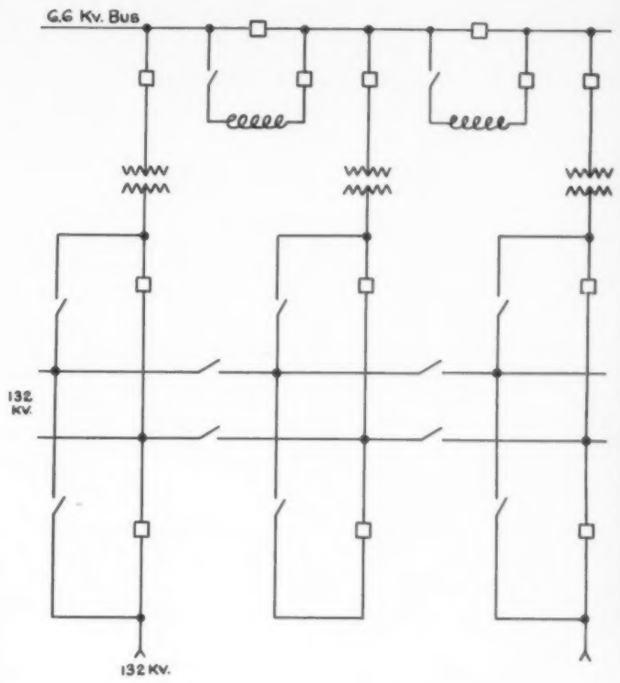


Figure 4—Single line diagram of a high tension substation supplying a mill that is fed from a utility.

power and generation of less in the mill. This is easy to understand when we take into account the time that is necessary to install generating capacity, even an addition to an existing station. The construction schedules of many of the new mills being installed do not permit this time interval. The decision depends to a considerable extent upon the available amount of what would otherwise be waste fuel. But where this condition does not enter the picture, we find an increasing tendency toward the purchase of utility power. Examples of this trend are the 30,000 kw. block contracted for by the new Carnegie-Illinois Steel Corp., mill at Gary and similar arrangements by the Bethlehem Steel Company at Lackawanna and Sparrows Point. At Gary and at Sparrows Point a change was made from 25 cycles in the existing plant to 60 cycles for the new section in order to use utility power without the necessity for frequency changers.

Where the mill generates its own power, this will usually be at the voltage utilized by the load and the entire distribution system becomes a network or at least a loop or series of loops at generator voltage. The generating station bus arrangement in the past has been subject to many variations, but with the improvements in apparatus the tendency is to simplify the switching arrangements as much as possible, and at the same time sectionalize circuits in such a way as to minimize the spread of trouble from one circuit to another. The arrangement selected will also depend upon the size of the plant and upon whether the generating station is the primary source of power with maximum dependability or simply an adjunct to the main power supply, which comes from an outside source. Fig. 1 shows the diagram of a new installation to be made in one of the larger, more elaborate existing stations. For this plant a complete double bus is used, and in addition the two buses are sectionalized for further flexibility and safety. This permits the maximum segregation of the different mills for greatest reliability of service. The future addition of a turbine is provided for by a synchronizing bus as a tie for the three main generator sections, and this will permit parallel operation without increase in breaker interrupting duty since the synchronizing bus reactors will limit short circuit current to the rating of the breakers now being installed. In this case we have not only the mill generating station, but also incoming lines at 44 kv. from other generating stations in the power supply system. Note that generators and most of the other circuits are also provided with reactors.

Modifications are contemplated in another generating station which has previously used a double bus scheme, but in this case a change may be made to a sectionalize ring bus or a synchronizing bus arrangement, using the same physical bus structure now used for the double bus. Studies so far seem to make this change desirable to obtain better voltage regulation and reduce breaker interrupting duty. The requirements of each local situation must be considered to decide the scheme best suited to the conditions.

Fig. 2 is a single line diagram of an existing steel plant distribution system and is more or less typical of the arrangement for such a mill. The relay protection of such a system must be worked out carefully so that not only will the circuits clear when they should, but so that they will not trip unnecessarily and cause shutdowns to other parts of the system.

Modern practice dictates the serving of the important mills in the plant with at least two circuits, each of sufficient capacity to carry the load alone. When this is done, it is possible to use balanced current relay protection on the two circuits, the relays being so arranged that when one circuit trips out, protection of the overload type is retained on the other circuit. Although the majority of plants still use overhead lines, continuity of service would seem to make desirable the use of underground lead covered cables, thus eliminating one great source of outage—lightning.

In order to reduce interrupting ratings of breakers required at the receiving end of the feeders, sectionalized buses with reactors or synchronizing buses are used. Fig. 3 shows the diagram of such a structure as used in the Ford Motor Company hot strip mill substation. Note that each of the five so-called load bus sections has an incoming line with two such circuits on the synchronizing bus, one an incoming line, the other a tie to another substation. The number of sections is determined by the number and size of the feeders, the breaker interrupting duty desired, voltage regulation, and similar factors. The same plan but with fewer bus sections is used in the Ford cold mill, glass plant and arc furnace foundry, and the present intention is to use the same scheme for all future major load centers in this plant. By this means the breaker ratings are held down to 250,000 kva., although the power house bus which supplies the feeders requires 1,000,000 kva. breakers. This entire distribution system is 13.8 kv. and is composed of underground cable throughout. Differential protection is used on the synchronizing bus with directional and overcurrent relays on the incoming feeders.

The design of the balance of the distribution system, that is, the smaller load center groups, will depend principally upon the load to be served, the relative locations of the different mills with reference to each other and to the main substation or generating station, and similar factors. In order to simplify operation and maintenance, it will often be found desirable to combine smaller groups of circuit breaker units, even though the control of the breakers may be located at

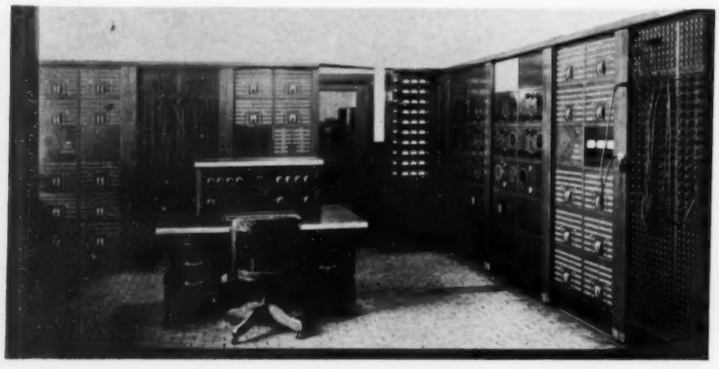


Figure 5—Calculating board or table of the type used by the major electrical manufacturers and a few of the largest utility companies, as a method of analysis.

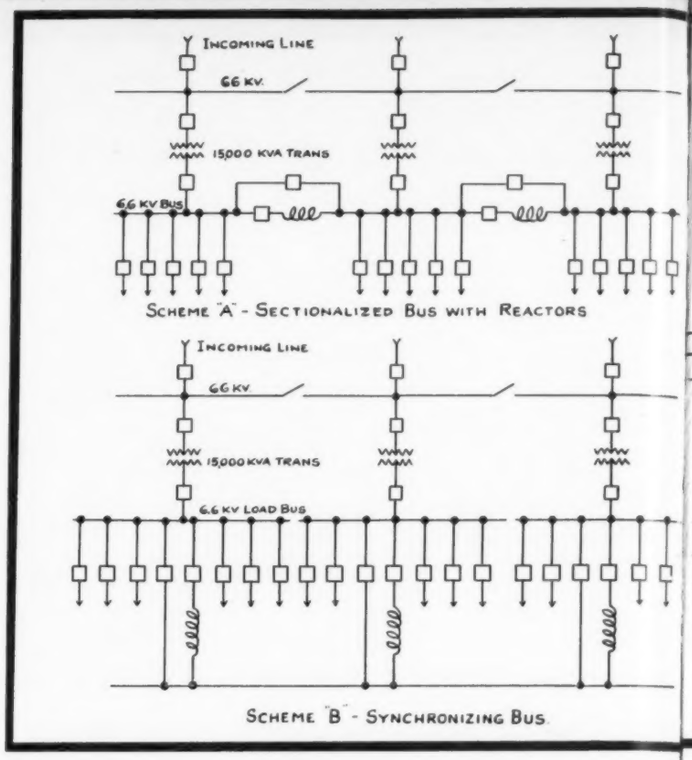


Figure 6—Two substation circuit arrangements, a sectionalized bus and a synchronizing bus with separate load buses.

the scattered load locations. The new Bethlehem mill at Lackawanna follows such an arrangement; the metal-clad circuit breaker structure for both hot and cold mills being located in the hot mill motor room with remote control of the breakers for the cold mill mounted in the cold mill motor room. This simplifies operation, groups the relays and circuit breakers for testing, and reduces the length of secondary connections.

In the future it may be necessary for steel companies to consider seriously the use of 11 kv. or 13.8 kv. distribution voltage for supply systems rather than 6.6 kv. which has been standard for many years. As previously stated, the load concentrations have become greater and the currents involved necessitate very heavy cables. Not only are the normal carrying capacity requirements high, but short circuit currents on 6.6 kv. also necessitate very heavy bus and cable supports. At least one company has had trouble from insulator pins snapping off due to these high fault currents. In making comparisons, it must be considered that 13.8 kv. synchronous and wound rotor motors will cost 10-20% more than 6.6 kv.

In regard to protective schemes for the layouts we have discussed, modern protection for generators consists of ratio differential relays, which are also standard for transformer banks. The buses should have fault bus protection or bus differential. Incoming and outgoing circuits will preferably have directional overcurrent relays, unless they are "dead-end" feeders, in which case plain overload protection will be sufficient. Where the loop circuits are relatively long, the impedance type relay may be used to obtain greater selectivity not obtainable with either overload or plain directional relays. The impedance relay contains a

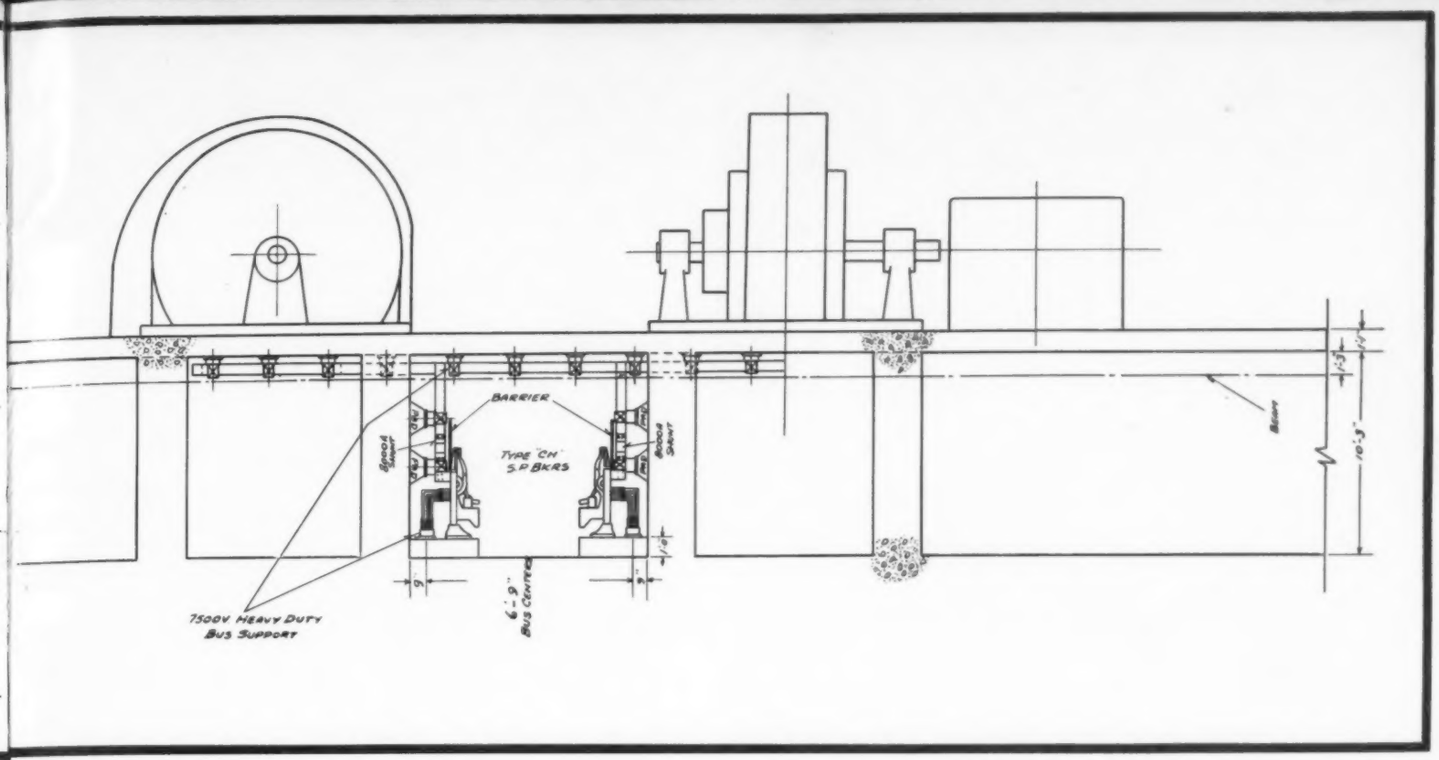


Figure 7—Segregated bus arrangements with the D.C. mill motors on the right and the M.G. sets on the left side of the motor toom.

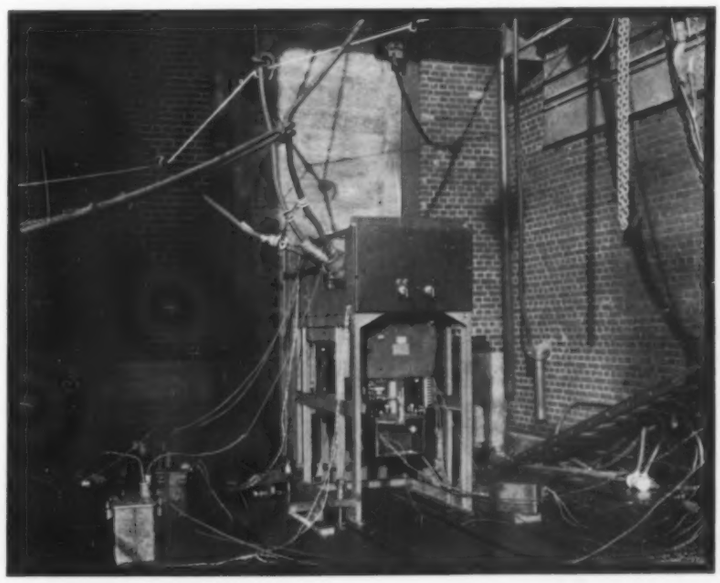
voltage restraining element, in addition to directional and overcurrent, the restraint depending upon the voltage and consequently the distance from the fault. Hence, the term often used to designate the device "Distance Relay." The latest development in relays is the high speed type, which, however, usually is better adapted to the higher voltage transmission systems where it is necessary to trip out faulted circuits rapidly to preserve stability and maintain distant stations in synchronism. Also, such relays are of little value unless the breakers are of correspondingly high speed. They are available in all the usual forms, overload, overcurrent directional, ratio differential, current balance, impedance, etc.

Coming now to the type of mill fed from a utility, Fig. 4 is the one line diagram of a high tension substation supplying such a mill. This is the 60-cycle substation feeding the new Gary mill from the system of Northern Indiana Public Service. Note that there are two 132 kv. incoming lines feeding a sectionalized double bus, and so arranged with three transformer banks that almost any combination of these banks with the two lines may be set up. In addition to this feature, the disconnecting switches permit complete isolation of any one of the three bays from the others for safe maintenance work.

Protection of such a substation involved some rather unusual features and careful application work. The lines at the sending end are equipped with current balance relays and impedance directional relays. At the substation end are high speed balanced directional overcurrent relays, with straight overcurrent protection for single line operation, and directional high speed ground relays.

It will be noted that there is a transfer breaker which ties the two buses together and by means of the disconnecting switches may be used either as a line or as a transformer high tension breaker. It is equipped with a complete set of line relays for use as a line breaker and overload relays for use as a transformer breaker. Auxiliary switches on the disconnecting switches and breakers set up the current transformer secondary circuits for proper relay operation. The transformers normally have differential protection.

Figure 8—De-ion grid setup in the test cell. Note that the test in this case is being made not only on the breaker but on the metal-clad switch-gear unit as well.



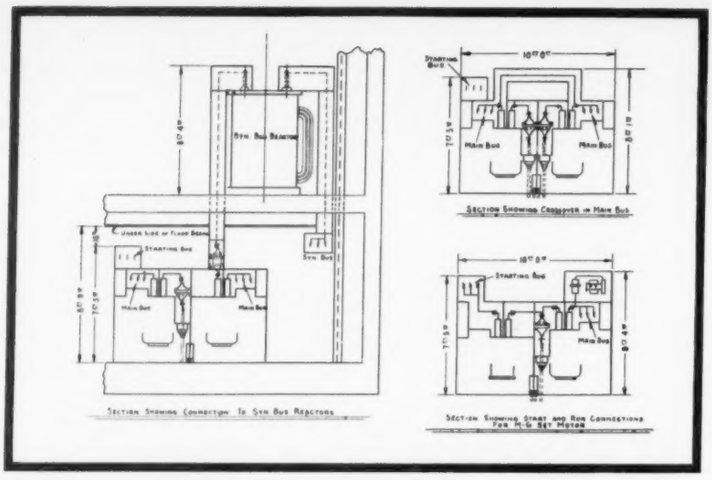


Figure 9—Cross section view of the relative locations of the different physical parts of the switchgear structure in use at the Ford Motor Company hot strip mill substation.

For this particular mill three feeders from the transformers in the substation supply the main 6600 volt bus which in turn feeds the smaller load centers for the various mills. The bus is sectionalized by reactors and reactor short circuiting breakers in comparison to the synchronizing bus scheme previously described.

In laying out a system of this kind a careful study must be made of various bus and substation arrangements so that the most economical scheme shall be selected. The decision should take into account ratings not only of circuit breakers, but also reactors where required, including their losses under notmal circuit conditions, voltages on various bus sections under full load and under fault conditions, cable costs, etc. The most convenient method of analysis is by means of the calculating board or table which the major electrical manufacturers and a few of the largest utility companies now have. See Fig. 5. Upon such a board the complete system may be set up, and short circuit current and voltage readings taken under different conditions. Modifications in the scheme may readily be made, reactor values varied, load distribution changed, and the effects determined immediately by readings on the instruments.

A simple example of this method is shown in Fig. 6 which indicates two substation circuit arrangements, a sectionalized bus and a synchronizing bus with separate load buses. The transformers are 15,000 kva. The three bus sections, with the distribution of circuits finally decided upon, have the following synchronous loads: 16,400, 12,150, and 23,400 kva. Calculating board setups were made with different values of reactance for both schemes and a check made as to the use of both induction and synchronous motors to drive the M.G. sets. It was found that with the sectionalized bus scheme, 13% reactance transformers and 13% reactors, the voltage on a non-faulted bus during a fault on one of the other buses would be from 57% to 93% of normal with induction motor M.G. sets and 64% to 93% with synchronous motor sets, depending upon the particular bus upon which the fault occurred.

With the synchronizing bus scheme and the same reactances the voltages were 75% to 82% for induction motor sets, and 78% to 83.5% for synchronous sets. Changing the reactors to 11% and the transformers to 18% gave a corresponding voltage figure of 81.4% to 85.5% for either type of M.G. set driving motor. From this standpoint the latter combination appears the preferable one.

An analysis of this kind will also show the effect of varying the distribution of synchronous apparatus on the different bus sections, both as to voltage regulation and breaker interrupting duty.

Similar checks to those for voltage are made to obtain the breaker interrupting capacity required under various conditions of circuits and different values of reactance both in the transformers and the reactors.

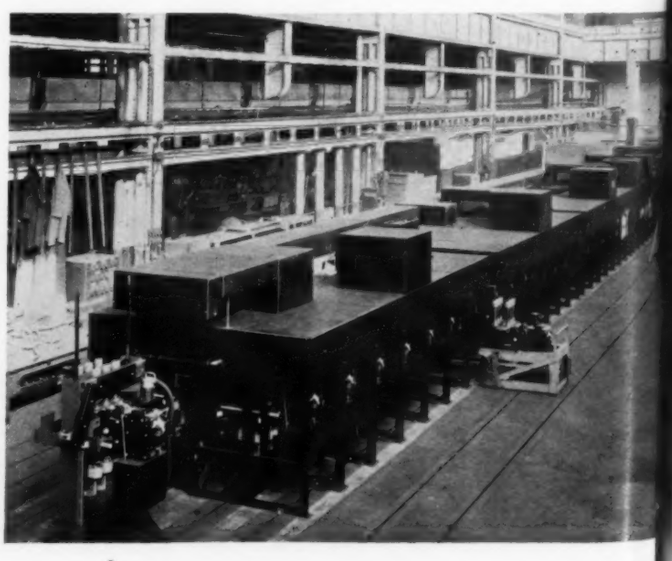
It is often desirable to check not only the interrupting duty required under present conditions, under the maximum expected kva. available on the high tension bus, but also, as a further check, to calculate the effect on the 6600 volt load buses if infinite capacity were available. Determination may also be made of the maximum synchronous load which can be placed on any one section (regardless of transformer loading) without exceeding an assumed circuit breaker interrupting rating.

With the above information available, the most economical arrangement may be selected with the certainty that the principal determining factors have been properly considered. No one bus arrangement should be assumed the best for all conditions.

In the particular example cited the synchronizing bus scheme showed the most advantages and will probably be used. In another instance perhaps the single bus with sectionalizing reactors would prove the most economical. This was the case for the installation at Gary, as shown by Mr. Bates in his paper in the Iron and Steel Engineer, July, 1936.

Although not strictly part of the distribution system, the main 600 volt d.c. system in a modern mill merits special attention and might be briefly mentioned here. With the enormous concentration of d.c. energy in a continuous strip mill the design of buses and conductors

Figure 10—Switchgear structure as it appeared in the factory before shipment. One of the breaker units is shown withdrawn on the transfer truck.



becomes an important problem. Some mills have as many as 5—4500 hp. motors and 3—6000 kw. M.G. sets concentrated in comparatively small space with very short connections. For installations of this kind it is becoming standard practice to locate the two polarities of both buses and connections several feet apart, together with their single pole breakers. With this arrangement short circuits are not only less liable to occur, but if they do occur, the effects are minimized and stresses are so limited that a more normal bus supporting structure may be used than if the two polarities were separated by a short distance of perhaps 15 to 18 inches. With the latter conditions, stresses of 5000 to 6000 pounds per running foot under short circuit would be attained.

Such a segregated bus arrangement is shown in Fig. 7, with the d.c. mill motors on the right and the M.G. sets on the left side of the motor room. The breakers are located on the center lines of the connections, being staggered along the structure. In some cases, the individual breakers are rotated 90° from the position shown to facilitate the connections.

APPARATUS FOR DISTRIBUTION SYSTEMS

Now let us turn to some of the modern switchgear for a mill distribution system. Circuit breakers have become in the last five years much more reliable than ever before, due particularly to two things, the fundamental research and development work on arc interrupting elements, such as the De-ion grid, and the high power testing laboratories which have been available for proving, step by step, the various design features, and showing the way for their modification. Fig. 8 pictures such a setup in the test cell. Note that the test in this case is being made not only on the breaker, but on the complete metal-clad switchgear unit as well, proving the ruggedness of such important features as the bus and connection supports, contact insulators,

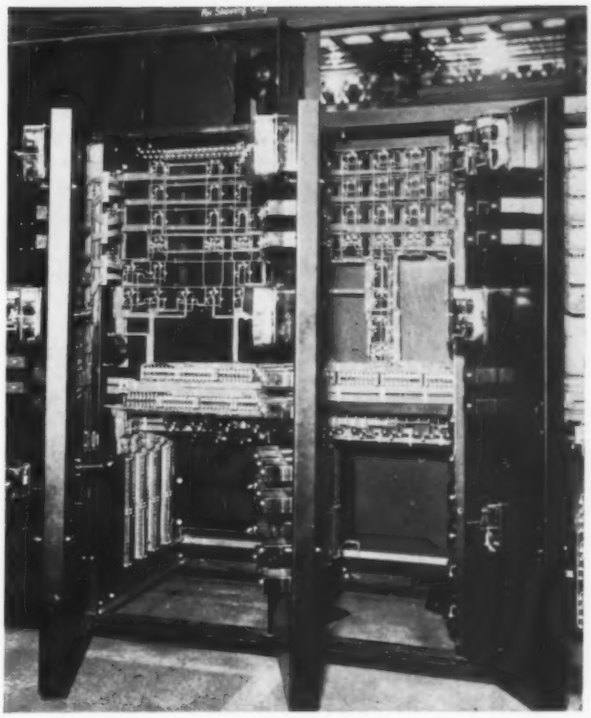


Figure 12—The watthour meters and certain protective relays located on hinged panels at the rear of the desk.

breaker supporting and elevating mechanism and current transformers. The picture shows also the potential transformer (at the left), which records arc drop across the breaker contacts, and (at the right) the pressure gauge for registering the breaker tank pressure.

Oil circuit breakers, particularly, have been greatly improved, not only as to successful interruption of the

Figure 11—A typical steel desk for controlling line and M.G. set motor breakers.

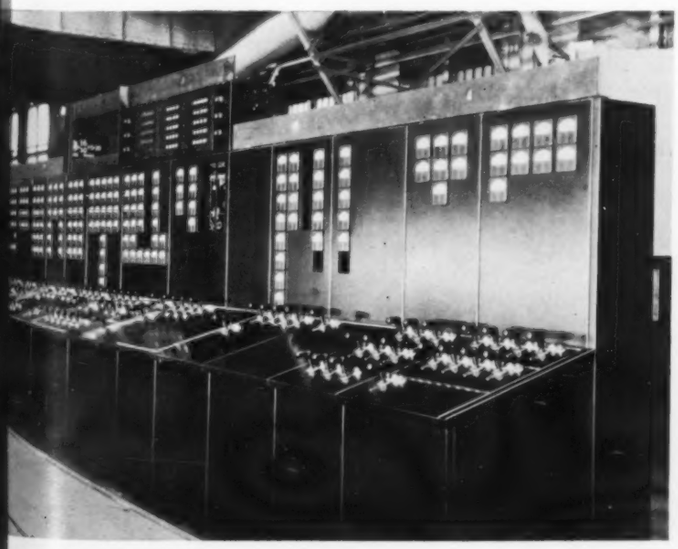


Figure 13—Metal-clad switchgear of the horizontal drawout type with each breaker mounted on its own wheeled truck.

arc, but to bring about a reduction in arcing time and consequent oil deterioration, and to permit a larger number of breaker operations before maintenance is required. This also involves improvements in the operating mechanisms, which are now almost universally of the solenoid type.

Every modern mill installation has used metal-clad switchgear as the incorporating structure for the circuit breakers. Of course, such a structure appeals to steel mill men because of its metal construction. But aside from this, there are definite advantages of safety, reliability, simple installation and operation, which have brought this type of equipment to its present favorable position.

The stationary housing of the vertical lift type metal-clad unit contains the insulated connections and bus, instrument transformers, and means for raising and lowering the oil circuit breaker to and from its operating position, where, by means of the primary disconnecting contacts, it is connected to the bus and incoming or outgoing circuits. This elevator on the heavier (500,000 kva.) units is usually motor-operated for convenience. On the smaller units it is hand-operated. Following out the idea of reduction in maintenance, the disconnecting and main circuit breaker contacts are silver plated to prevent reduction in current carrying capacity due to oxidation of copper. Copper tungsten is usually employed for breaker arcing tips.

Incorporated in the metal-clad structure may also be small operating transformers, current limiting and starting reactors, and auto-transformers with necessary interconnections. Where starting buses or synchronizing buses are required, these are also metal-clad.

The diagram of the Ford Motor hot mill substation, Fig. 3, has been described previously. A cross section, Fig. 9, shows the relative locations of the different physical parts of this switch-gear structure. There was insufficient room on either the motor room or lower floor to locate the entire structure. Consequently, the switchgear proper and the starting reactors were located below and the synchronizing bus reactors on the motor room floor. All reactors are the oil-immersed type. Note the complete metal-clad connections between the switchgear and reactors, and between reactors and bus. Similar connections to the starting reactors are used. The load bus sections are located both front and rear of the main units, with the starting bus above at the rear. With the drawings previously shown, Fig. 10 more clearly pictures the switchgear structure as it appeared in the factory before shipment. One of the breaker units is shown withdrawn on the transfer truck. At the left is the test rack and just behind it the connection compartment for the starting reactor. In the distance may be seen one set of connection compartments for a synchronizing bus reactor, and at the right a section of the synchronizing bus temporarily supported. These units carry no meters or relays, which are mounted on a separate switchboard.

Figure 14—Two ten foot sections of a metal-clad bus run, one section with the top removed.

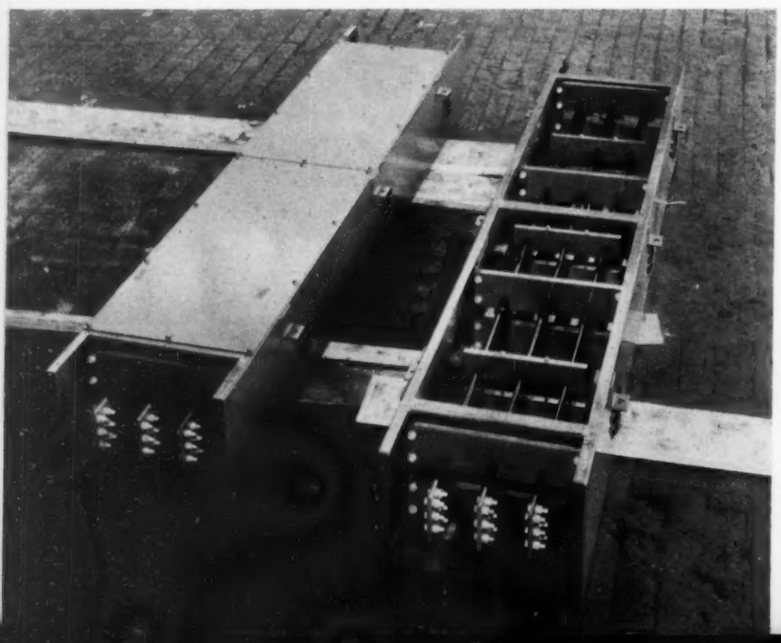


Figure 15—Partial assemblies of bus runs which are later to be used for connections between the switchgear structure and the transformers.

Mention has been made of the fault bus scheme of protection for buses. The metal-clad type of structure is particularly adapted to this scheme, which has not been in general use heretofore. Each section which it is desired to protect and segregate from other sections has its own fault ground bus to which the metalclad structure is connected. This fault ground bus connects to the station ground through a current transformer, the secondary of which operates a protective relay. Since the metal enclosure completely surrounds all conductors, any trouble will originate as a ground, or will quickly develop into one, and if each metal enclosure section is insulated from other sections and from ground, except through the fault bus, ground current will have to pass through the fault bus current transformer and operate the proper relay. By means of auxiliary multi-contact relays, all breakers necessary to clear the faulted section of bus may be tripped simultaneously. For a single bus structure this is a somewhat simpler scheme than a bus differential with current transformers on each circuit and has proven very successful on even the largest power stations. It involves some complications when used on double bus structures.

Modern practice is to mount directly upon the metal-clad units switchboard panels, which may carry the entire complement of relays, meters, and control switches. This minimizes installation work and testing in the field, and in addition keeps down the length of secondary cables. Where a separate switchboard or control desk is used, as is necessary for motors controlled from the mill, protective and interlocking relays may still be mounted on the metal-clad units. Individual starting reactors with the necessary short circuiting breakers and other auxiliaries are usually mounted in metal-enclosed cubicles at the motor.

Switchboards and control desks are now built of steel as a matter of course, which permits complete assembly in the factory, wiring and testing, and shipment of several panels or sections in an assembled group to still further assist installation work. Rectangular instruments and relays are now standard with the tendency toward flush mounting of the instruments.

A typical steel desk for controlling line and M.G. set motor breakers is shown in Fig. 11. It was shipped in four assembled groups, each group tied together by means of a heavy angle for shipping. The meters are flush type indirectly lighted, and the annunciators are mounted above the instrument panels. When this picture was taken all meters had not yet been mounted.

Fig. 12 shows watthour meters and certain of the protective relays located on hinged panels at the rear of the desk. This view also shows the complete wiring in place and tested prior to shipment from the factory.

Reactors of both the open and the oil-immersed type have been used on recent installations. Where the open type is employed, grill work or sheet metal housings are used to enclose them.

The De-ion air breaker has also been used in place of oil breakers in several important installations. Oil is entirely eliminated and a larger number of operations without maintenance is possible. This type of breaker is particularly adapted for severe duty, such as on reversing mills and is somewhat more expensive than an oil breaker of corresponding rating. An application for arc furnace duty is now being made, where the number of operations is of the order of 75 per day.

For these breakers, on account of their form of construction, the metal-clad switchgear is of the horizontal drawout type with each breaker mounted on its own wheeled truck as indicated in Fig. 13. The same insulation and bus construction are used as on the vertical lift type, and the same practice of mounting relays on the metal-clad unit panels may be followed as shown here.

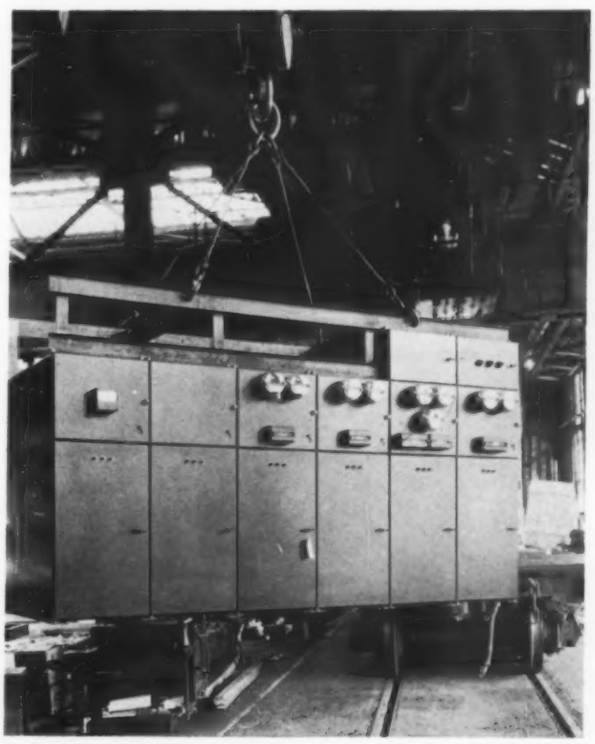
An additional development recently is the increased use of metal-clad bus and connections runs for interconnections between transformers or generators and switchgear, reactors and switchgear, etc. This type of construction has been used in place of cable runs for heavier current circuits, and has worked out very satisfactorily from the installation, operation, and cost standpoints. Pictured in Fig. 14 are two ten-foot sections of a metal-clad bus run, one section with the top removed. The conductors are micarta insulated copper bars rigidly supported by micarta slabs. The joints are silver plated and insulated by a moulded insulating cover filled with compound in the same manner as on the metal-clad switchgear units. Partial assemblies of bus runs which are later to be used for connections between the switchgear structure and the transformers are shown in Fig. 15 on the shop assembly floor. Even irregular connections may be readily made by this means to suit various building layouts.

The maximum advantage of factory-assembled switchgear is obtained when several units may be shipped togther in a group with all cross connections complete as shown in Fig. 16. This practice is becoming general to reduce installation time and cost. Handling means are provided for convenient hooking on by a crane, and the units are usually welded together to prevent shifting during shipment.

Fig. 17—Here we have a switchgear layout quite similar to the De-ion breaker structure shown in Fig. 13. except that the breakers are of the De-ion grid oil type, and the units are vertical lift metal-clad. Also the breakers are withdrawn from the opposite side to that on which the panels are mounted. This type of switchgear structure, using 500,000 kva. breakers, has been used to a large extent in recent heavy steel mill installations.

Earlier mention was made of the heavy d.c. short circuit currents which may be experienced in modern continuous strip mills. The development in breakers to take care of this condition may be appreciated from the two breakers shown in Fig. 18. The breaker at the left is the carbon arm and ellyptic brush type which was adequate for 600-volt railway service and was tested at approximately 110,000 amperes on the New

Figure 16—Several units may be shipped together in a group with all cross connections complete; the maximum advantage of factory assembled switchgear.



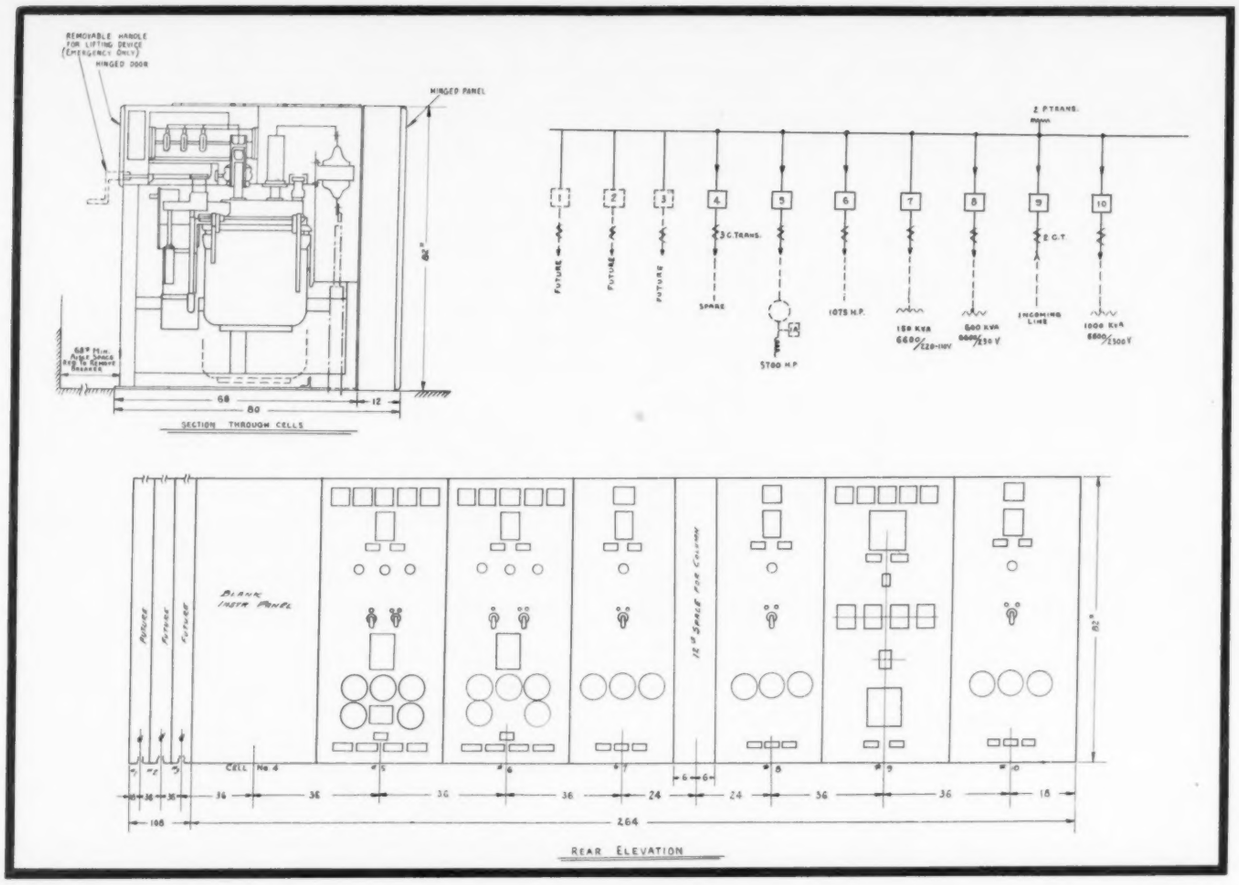


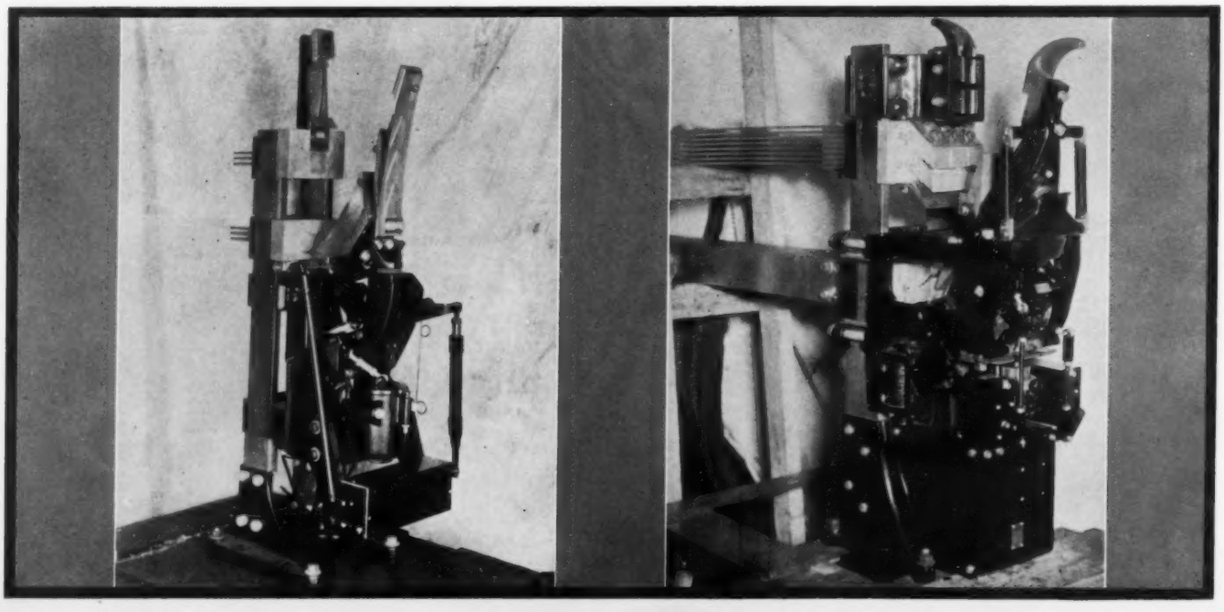
Figure 17—Switchgear layout similar to that shown in Figure 13, except that the breakers are of the De-ion grid oil type, and the units are the vertical lift metal-clad.

York subway system, formerly the heaviest concentration of such power. However, to meet 200,000 or 300,000 ampere duty, such as steel mills now require, the entirely different structure shown on the right was developed, using the reversed brush main contact, so successful in heavy capacity power house oil breakers, and four sets of auxiliary contacts including the arcing horns at the top. This breaker has successfully interrupted 495,000 amperes at 400 volts a.c. without damage to the main contacts. Note that both breakers are pedestal type, mounted on insulated steel columns, and adapted to a layout such as is shown in Fig. 7.

CONCLUSION

In conclusion, it is perhaps unnecessary to say that the distribution system in a modern steel plant has become an exceedingly important part of the overall design. In this rather general paper it is hoped that some points of interest have been brought out, and perhaps features mentioned which will suggest some new thoughts in handling the problem, and that other papers dealing with the subject may be presented.

Figure 18—The breaker at the left is the carbon arm and ellyptic brush type while the one at the right uses the reversed brush main contact.



MECHANICAL TRANSMISSION

Choosing The Correct Method

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Presented before the Philadelphia District Section, A. I. & S. E., March 6, 1937

▲ FUNDAMENTALLY, what is plant engineering? It is the planning to accomplish a purpose and the art of diagnosing the cause of plant operating and mechanical difficulties; and subsequently the application of remedies or equipment that will successfully and economically solve the problem.

To overcome engineering difficulties, regardless of their nature, the remedies must be practicable and the equipment selected of correct design and type for the particular requirements. Occasionally this is difficult, in view of a similarity of the basic characteristics of modern engineering equipment. This basic similarity prevails in the various methods and types of equipment employed for transmitting power mechanically. This factor, in many instances, is the cause of improper selection.

WILLIAM STANIAR

The correct and economical solution of driving problems depends upon a realization that the subject of mechanical power transmission is most important and that its primary requisites must be understood. It is important because of its necessity in practically all industrial operations. Regardless of the method employed for generation, power is usually applied mechanically. Therefore, unless the most adaptable equipment and methods are employed for modern operating requirements low efficiency, loss of production and high maintenance costs result. These modern requirements involve mechanically, high velocity ratios, infinite variation of applied speed, rigidity or flexibility, high starting torque resistance, shock and vibration, overload release and compactness; they involve atmospherically, the deleterious action of acid fumes, the abrasive damage of various dusts and the destructive effects of high temperatures and excessive moisture.

The primary requisites are (1) the realization that mechanical power transmission is a definite engineering subject and not simply an auxiliary; (2) that it is composed of two general systems; (3) that each system is composed of several methods; (4) that each method is composed of several accessories; and (5) that each method of each system is adaptable for a definite purpose. A conception of these facts assists in selection, since irrespective of the mentioned mechanical and atmospheric situations induced by modern industrial operations, mechanical power equipment and methods have been developed to cope with all requirements. Regardless, however, of such development and the availability of suitable equipment, maintenance, power and shut-down losses are continuously evident. This is so because the economic importance of correct mechanical power equipment is frequently overlooked.

The magnitude of the investment in equipment of this character and the savings possible by the utilization of available knowledge on the subject are possibly not apparent to the average executive and engineer. As an example, one of the largest industries in this country (The duPont Company) has a manufacturing equipment investment of approximately $200,000,000.00. A conservative estimate of 3 percent or $6,000,000.00 is vested in mechanical power equipment. The average life of correct mechanical power equipment is estimated at six years. The annual replacement cost is therefore $1,000,000.00. Experience has proven that incorrect equipment of this character shortens the average life period to four years. On this basis and for a similar investment, the annual replacement expenditure would be $1,500,000.00, an increase of $500,000.00 per year. Mechanical power equipment cost figures such as these are staggering, but nevertheless are true of all industry in direct proportion to the investment.

Modern mechanical power application must of necessity be divided into two general systems—the "Flexible" and the "Rigid", and each system further divided into various methods. These divisions tend to avoid wrong selection of driving method, wrong arrangement of the method selected and faulty care and lubrication of the transmission accessories involved. The losses experienced in the accessories of the method applied are generally the ultimate effect and not the cause of the trouble.

When confronted with the problem of choosing the correct transmission method, it is of primary importance to decide which general system is most applicable to the character of the load and the equipment to be driven. This is forcefully demonstrated by the following experience.

A ball mill containing 40000 lbs. of steel balls and 12000 lbs. of ore was driven by a 250 hp. at 500 r.p.m. synchronous motor, flexible coupled to a 450 hp., 2.7 to 1 ratio herringbone gear unit rigidly coupled to a 6 in. dia. pinion shaft of the ball mill. A forged steel cut spur pinion—14 in. P.D. x 1½ d.p. x 13 in. face operating at 185 r.p.m. meshed with a split cut cast iron ring gear,—123 in. P.D. x 1½ d.p. x 13 in. face, bolted to the shell of the mill. The mill operated at 21 r.p.m. The herringbone gear unit was designed for 450 hp. to accommodate the heavy starting torque load of the ball mill. Such an assembly resulted in a rigid power transmitting connection between motor and mill and supposedly was correct and ideal. Trouble was experienced almost immediately. The bronze sleeve type bearings on the slow speed shaft and the outer races of the bearings on the high speed shaft of the gear reduction unit failed by cracking, the foundations supporting the pinion shaft bearing base plate cracked and finally the pinion shaft bearings were torn loose from the base plate.

The case was perplexing since after each failure and repair, the alignment and setting of the entire installation was thoroughly checked. The final diagnosis and subsequent correction proved, that in view of the character of the load and the integral spur gearing of the ball mill, the rigid system of transmission had been mis-applied. Severe shock and continuous vibration were caused by heavy starting torque conditions, the cascading action of the balls in the mill and the tooth backlash of the spur pinion and ring gear, which in the absence of a flexible and shock absorbing transmission medium collided with the vibrations generated in the herringbone gear unit. This condition caused a concentration of vibratory or fatigue stresses in the bearings of the reducer and along the pinion shaft of the mill.

The difficulty was overcome by substituting a 450 hp. splash lubricated silent chain drive of 2 in. pitch x 18 in.width for the herringbone gear unit as a connection between the motor and pinion shaft of the mill. It is evident that the shocks and vibration generated by the ball mill and its integral spur gearing are now absorbed and dissipated by the flexible chain connection, since the installation operating 24 hours per day for the past two years has given perfect satisfaction with practically no maintenance. An incident of this character substantiates the claim that fundamentally the success or failure of a transmission-installation depends upon the system selected.

THE FLEXIBLE SYSTEM

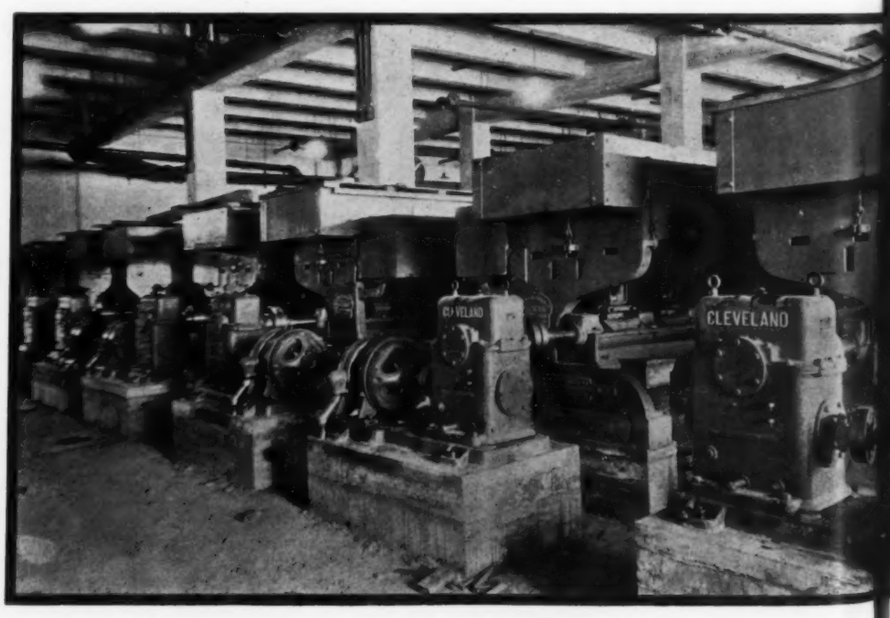
This system is composed of the following methods:—
1—Modern group—employing belting
2—Modern group—employing chain
3—Chain direct
4—V-belt
5—Pivoted motor—gravity or reaction torque type
6—Flexible variable speed units
7—Wearn autoflex.

All methods of this system are shock absorbing and therefore tend to reduce the effect of load impact and vibration. Certain methods of this system possess an inherent characteristic of "slip" which in some instances is a protection to both prime mover and driven equipment.

THE RIGID SYSTEM

This system is composed of the following methods:—
1—Direct coupled motor
2—Worm gear reduction unit
3—Spur gear reduction unit
4—Herringbone reduction unit
5—Motorized reduction unit.
6—Open gearing
7—Combination of systems.

Worm gear reducers direct connected to a heavy steady load.



All methods of this system are nonelastic; therefore, resultant vibrations are localized and must be absorbed by the transmission equipment. Sudden obstruction in the driven equipment causes destructive shock to the rigid driving method. Flexible couplings of the torsional resiliency type tend to protect, but their real function is to compensate for misalignment and slightly cushion the effect of starting torque.

Destruction of transmission equipment, whether of the flexible or rigid system, by total jamming of the driven machine, can be avoided by the use of overload release couplings and to some extent, shear pins. Methods of the rigid system function with high efficiency, for light, moderate and heavy steady loads.

In view of a similarity of application for certain mechanical power methods of both the flexible and the rigid systems, parallel situations can be simplified by a consideration of the following generalizations:—

1—*High Starting Torque*—Injurious to any transmission method, unless relieved electrically or by mechanical means interposed between prime mover and load.

2—*Low or Moderate Starting Torque* — Controllable by friction clutch or tight and loose pulleys. Any method of either the flexible or rigid system is suitable for this condition.

3—*Power Requirements*—Fundamental basis for decision between group drive and direct connection, unless only one or two driven units are involved and the ratio of speed application is high.

4—*Intermittent or Steady Load* — Methods of the flexible system are more adaptable to intermittant or fluctuating loads, while those of the rigid system are more suitable for steady loads.

5—*Frequent Starting and Stopping* — Injurious to methods of the rigid system if high torque is involved and the power is high. Methods of the flexible system are more capable of absorbing such shocks. For the group method the friction clutch is the best control for this condition.

6—*"Across the Line" or Compensator Start Motors*—Starting torque should control this selection.

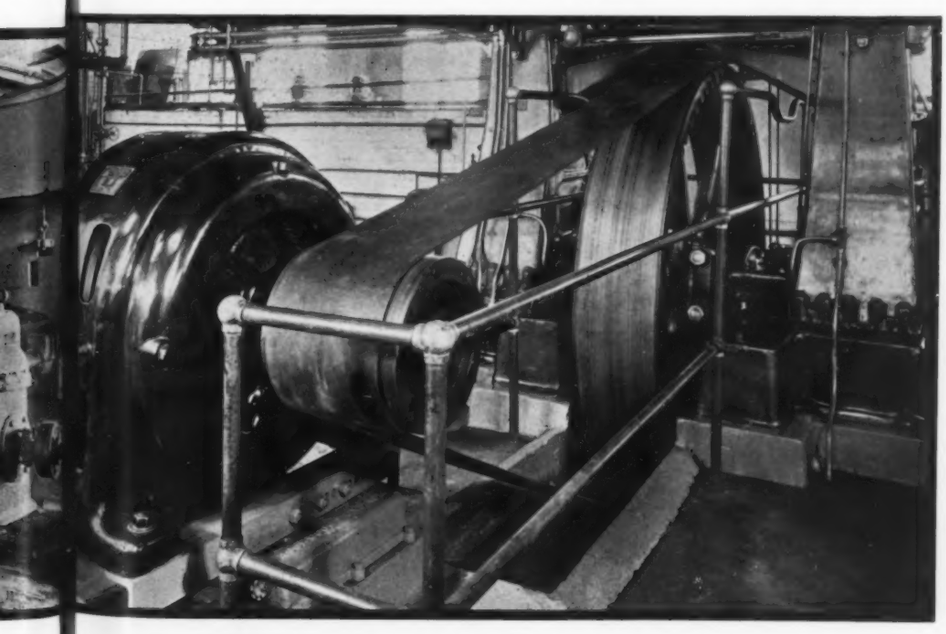
7—*Type of Motor*—"Slip-ring" for high starting torque, unless the acceleration of the load is assisted by a suitable mechanical device. "High starting torque" for moderate starting torque loads. "Standard Squirrel Cage" for all low torque drives and for high torque when connected to load through a mechanical high torque device.

8—*Dust, Corrosive Fumes, Flamable Vapors*—Dust of the abrasive type and corrosive fumes are injurious to any method of transmission, therefore under these conditions, methods capable of perfect enclosure should be used. Where flamable vapors exist, the hazard of static electricity and frictional heat must be considered.

9—*Spillage of Corrosive Acids*—This condition should prohibit the use of group drive by belting. Group drive by chain should have the chains totally enclosed. Under this condition all methods of the flexible and the rigid systems should be totally enclosed.

10—*Lubrication*—All methods of both the flexible and the rigid systems, with the exception of flat belting, V-belting, and pivoted motor installations require periodic lubrication. The lubrication should be of the correct type for the service and the method of application such that it is accessible and capable of furnishing the correct amount of lubrication at the right place at the right time.

100 H.P. gravity type pivoted motor base drive.



Group Versus Individual Drive

Before briefly discussing the merits and the differentiating characteristics of the various methods of the flexible and the rigid systems, a few remarks concerning this controversy should be made. In choosing between group and individual drive in industrial operations, the governing factors are arrangement of apparatus, power requirements, character of load and atmospheric conditions. Group driving by either belting or chain is particularly economical from a power, maintenance and first cost standpoint if (1) the driven equipment can be arranged in batteries either in line or in parallel; (2) the running load of each unit does not exceed 5 to 7 hp. for belting and 10 hp. for chain; (3) the starting torque of each unit is normal and (4) if the belting and other transmission appurtenances are capable of re-

sisting for appreciable periods of time a deleterious atmosphere. When the driven equipment must be moved periodically and the arrangement of such is scattered it should be individually driven, regardless of other characteristics. Group driving is power economy in that motorization can be based on a sum of the driven equipment running loads, plus friction, whereas individual motorization must be based on the starting loads. Direct motorization of small equipment tends to affect power factor adversely, since motors direct connected generally operate below their rated capacity.

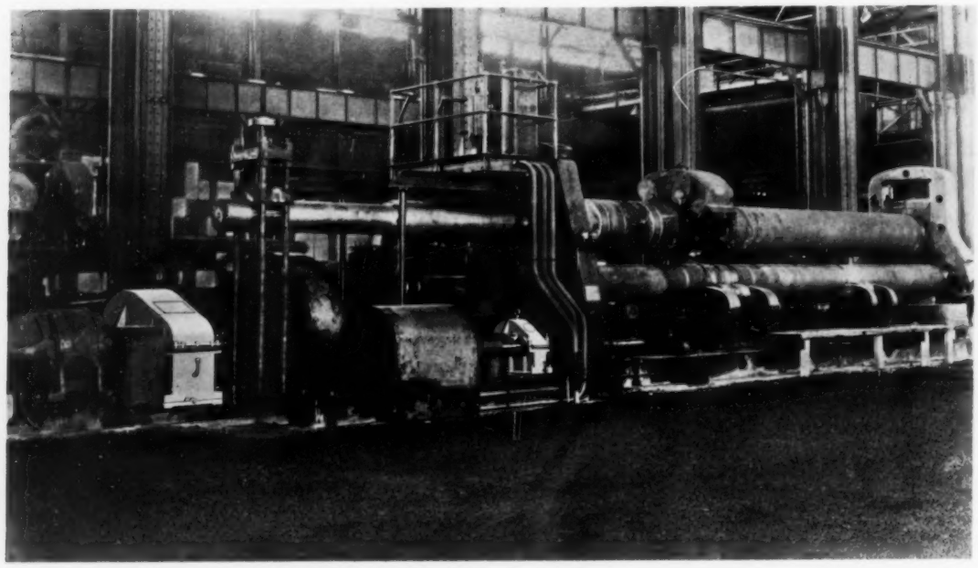
FLEXIBLE METHODS

Modern Group Employing Belting or Chain

These two methods are similar, with the exception that one employs belting from line shaft to driven equipment, while the other employs chain. Whether to use belting or chain as power distributors can be determined by four factors—(1) use chain when the speed is low and the power pull heavy; (2) use chain, clutch controlled, when load and speed require belting over 8 in. wide, since belting beyond this width is difficult to shift; (3) use chain when the starting torque is above moderate as excessive starting slippage is destructive to all belting types; (4) use chain where atmospheric conditions are severe, since dust and fume tight self lubricating enclosure is possible. The belting group method is applicable to both production shop and process plant operation for the driving of batteries of machines when the individual machine running load does not exceed 5 to 7 hp. The prime mover should not exceed 50 hp. The chain group method is used almost exclusively in process plant operations. The individual apparatus load should not exceed 10 hp. and the prime mover 75 hp.

Chain Direct

This method is applicable for the direct driving of line—or head-shafts and various types of machines and apparatus from motors operating at standard synchronous speeds from 720 to 1800 r.p.m. For low power requirements such as fractional to 3 hp., motor speeds of 3600 r.p.m. are practicable. This method requires either the "silent" or the "finished steel roller" chain, the choice being dependent upon speed, power and the mechanical conditions involved. Where flexibility, positive velocity ratio and short centers are desirable this method should be employed. Occasional shock loads, severe vibration and the problem of positive speed differential can be solved by the use of high speed chain connection. When of correct size for the power and speed and proper ratio, the chain direct method results in longer life than any other short center flexible method, provided proper lubrication and protection from abrasives are maintained.



Herringbone gear reducers direct connected to the heavy load of a sheet mill.

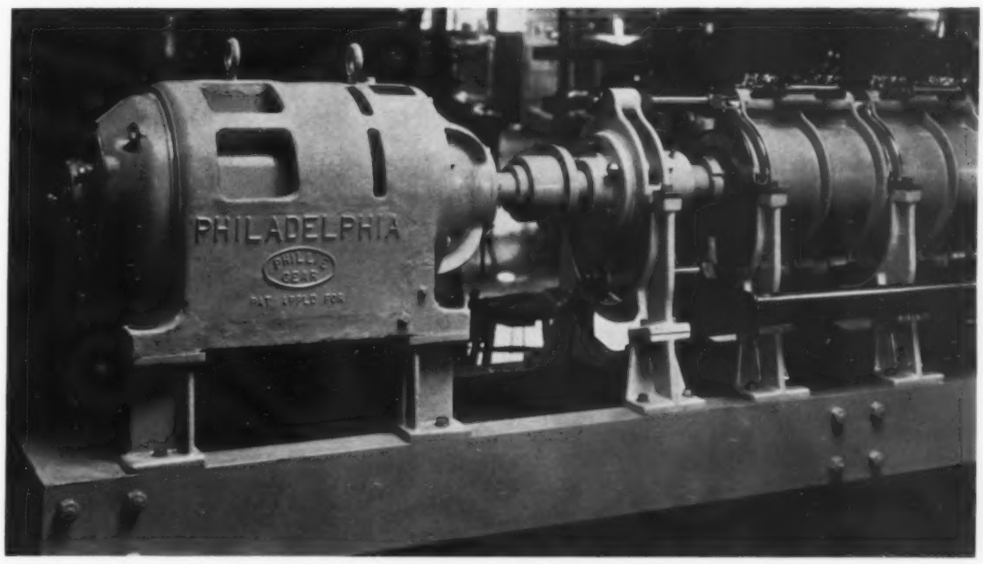
V-Belt

This method is applicable to either production shop or process plant short center driving of shafting and practically all types of industrial equipment. For the driving of production shop machinery it is of particular advantage where the absence of chatter is desirable. The unique principle of locking effect developed as the V-belt seats itself in the groove of the sheave is responsible for certain advantages of this method. These advantages are, (1) Short center distance with ratios to 8 to 1 since regardless of possible low arc of contact on the smaller sheave, excessive slip is prevented; (2) Ability to absorb shock and pulsating loads, based on a cushioning effect as the belt seats in the groove; (3) Low maintenance; (4) Low replacement cost, since renewal of belts is all that is necessary, and (5) The possibility of use on medium center drives. The V-belt drive must have center adjustment and it should be protected from mineral oil and grease. In process plant driving the factors which favor "chain direct" over V-belt are, (1) Shorter center distance for equal ratio; (2) Possibility of fixed centers; (3) Positive driving;

(4) Ratios to 12 to 1, and (5) Severe atmospheric conditions and abnormal temperatures.

Pivoted Motor

This is an efficient flexible method, utilizing flat belting of practically any type, (mineral retanned leather made endless preferred) on short centers. Two designs are available; the gravity type which automatically tensions the belt by the weight of the motor and the reaction torque type which employs a definite force inherent in all electric motors, which is at any moment equal to the force exerted on the belt by the armature of the motor. A particular attribute of either design is automatic belt tensioning, which accomodates belt stretch, centrifugal tension and load fluctuations. This method requires no adjustment facilities and is practicable for ratios to 7 to 1. The characteristics which assist in selection are, (1) Its efficiency is maintained at peak loads; (2) It overcomes centrifugal tension, and (3) Center adjustment is automatic.



Direct connected 50 H. P. horizontal motorized reducer. 1750 to 300 R.P.M.

Variable Speed Units

Mechanisms of this character are most always employed in connection with other transmission methods, therefore are classed under the flexible system only when their internal parts are of a flexible nature. In view of this, selection can be based on whether or not, in the combination, the variable speed unit must act as the flexible medium.

The Wearn Autoflex

This is a new driving mechanism for short center flat or V-belt installation. It provides extremely short centers, automatic adjustment of belt tension to load, shock absorption and high ratio capacity. It comprises a gear keyed to the shaft to be driven and a pinion which meshes with the gear. The pinion is driven by a belt pulley or V-belt sheave through a shaft which is carried in a floating housing pivoted on the driven shaft. When the pulley is revolved by belt from the motor it causes the pinion to make an epicylic movement around the gear and thus the driven shaft starts to rotate as soon as the torque, due to the belt tension balances the load resistance. Ratios of 10 to 1 up to 20 to 1 are a common requirement which cannot efficiently be accommodated with chain, pivoted motor or V-belt, therefore it is necessary to resort to gear reduction units of the rigid system or double reductions of the group method. The Wearn drive readily supplies such ratios flexibly and compactly.

Efficiency and First Cost Comparison

Basis 25 hp. 1800 R.P.M. Motor—Ratio 3:1

Equal Centers

		First Cost
Silent Chain	—eff. 97 to 98 percent.....	$ 92.00
V-Belt	— " 90 to 96 "	86.00
Pivoted Motor	— " 96 to 98 "	101.00

RIGID METHODS

Direct Coupled Motor

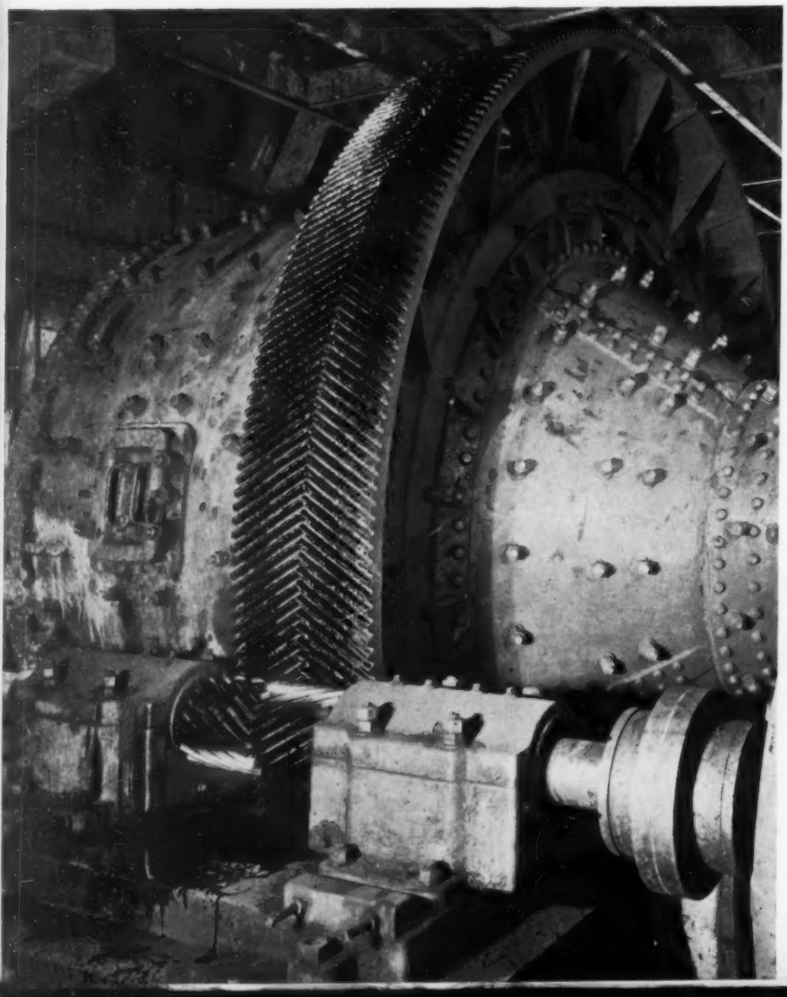
This is "direct connection" and generally signifies integral motor mounting with high speed input driving. The motor, whatever type, should be flexible coupled to the driven machine or apparatus. The selection factors for this method are that the input speed of the driven equipment must correspond with that of the motor and that consideration must be given to the starting torque. If such torque is severe, either the motor must be of the proper type to handle it, or special couplings must be employed between motor and load.

Worm-gear Reduction Unit

This method comprises both vertical and horizontal driving and is employed for both moderate and low output speeds. It is adaptable to almost any form of speed reduction whether the prime mover is a motor, turbine or an internal combustion engine, since at high worm speeds, when properly designed, these units operate quietly and efficiently. The factors governing selection of this method in addition to low installation cost, low depreciation, low maintenance cost and insurance against break downs are (1) high ratio possibilities in small space; (2) self correction against wear; (3) operation at high input speeds; (4) continuous load bearing capacity; (5) quietness of operation and (6) transmission of power at right angles. It is adaptable for fractional horsepower requirements and for heavy work, such as rolling mill screw downs. Permissible worm speeds range from 100 to 4000 r.p.m. with ratios to 100 to 1 for single reduction and 10000 to 1 for compound units. In single reduction gear assemblies the worm and worm gear possess higher ratio capacity than any other form of gearing. At the higher ratios, however, the efficiency is reduced. The power rating is in direct relation to ratio and worm speed. Although much higher ratios are possible with compound units, the horsepower capacities are relatively low, since the torque for a given horsepower varies inversely with the speed. In view of this fact the single reduction has a larger field in general industrial operations.

Spur Gear Reduction Unit

This method utilizes either the planetary or non-planetary gear assembly. The planetary type, which employs a fixed internal gear and orbit planet pinions is more extensively used in view of its higher efficient ratio capacity in double and triple reduction. This method is particularly suitable for the direct connection of line-shaft and for moderately powered loads where horizontal straight line driving is necessary. The factors favorable to this method over the worm gear unit are—(1) straight line driving; (2) higher efficiencies at high ratios and (3) compactness for equivalent power and ratio. Right angle driving is possible with this method, but is costly owing to the necessity of bevel or miter gears in conjunction with the standard gearing of the unit.



Ball mill driving by herringbone gears.

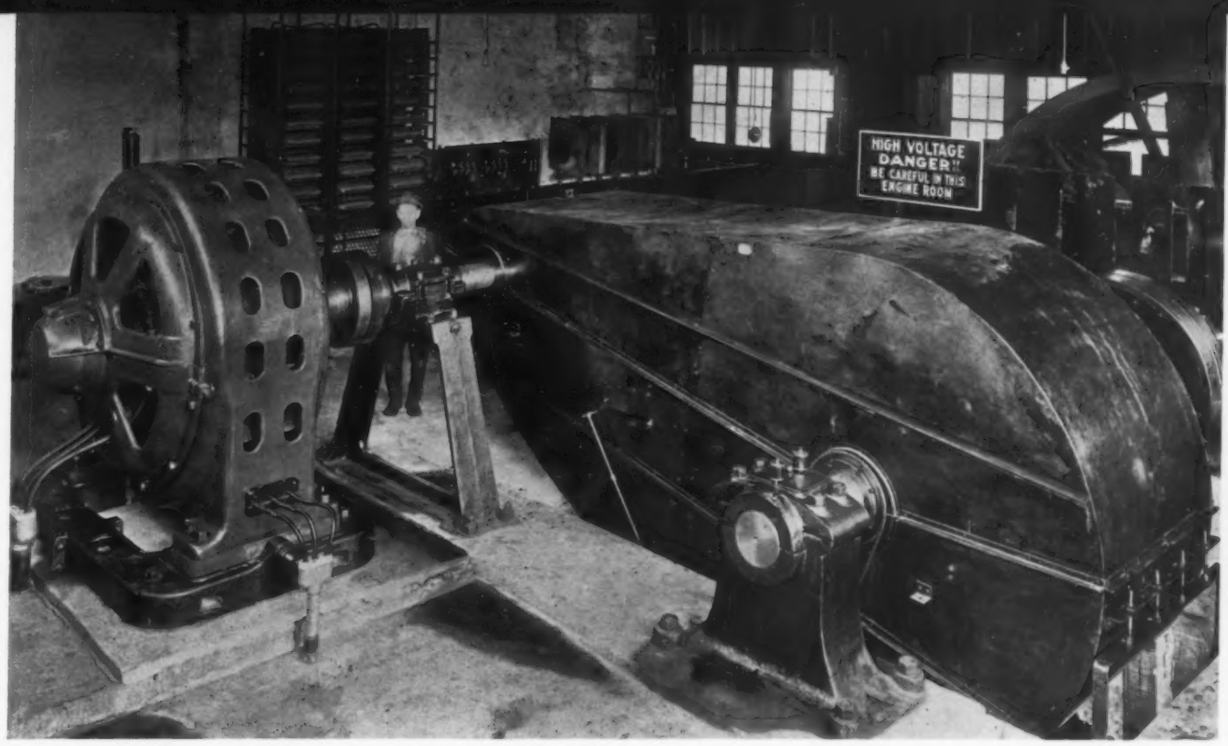
Motorized Reduction Unit

This method combines motor and gear assembly in one unit. It is manufactured with motor supported and gear reduction unit overhung, with gear reduction unit supported and motor overhung and with both motor and gear reduction unit supported. Choice of construction is a matter of opinion, since all three are built substantially, however, it would appear from a structural standpoint that a totally supported unit is superior to an unsupported one. Regardless of the employment of various types of gearing, the planetary assembly, and the helical gear assembly are the most popular. The advantages of this method are—(1) elimination of base plate and flexible coupling; (2) compactness, resulting in high ratio direct connection in small space; (3) permanent alignment of motor and reducer; (4) efficiencies equal to that of the gear assemblies employed; (5) accessibility of motor and reducer parts; (6) A.C. motors of any type can be employed; (7) ideal for both vertical and horizontal in line driving; (8) lower first and installation costs over separate motor and reducer within a certain power range.

The motorized unit should not be employed where (1) it is preferable to have the motor separate from the reducer in the event of motor trouble; (2) the power requirement exceeds 75 hp.; (3) the ratio requirement exceeds 180 to 1; (4) the ratio is low and the power high; (5) shock or high starting torque loads are liable and (6) where right angle driving is necessary.

Herringbone Gear Reduction Unit

This method is available in single, double or triple reduction with shafts in line or offset and maximum ratios of 10 to 1, 70 to 1 and 320 to 1 respectively. The power range for the single and double reduction in standard units is 1½ to 1300 hp. The triple standard reduction unit is available to 75 hp. The double reduction design with shafts offset is known as the "tandem" type, while with shafts in line it is termed the "box" type. Choice of shaft arrangement is generally governed by installation convenience. The factors which should influence choice of this method are—(1) continuous smooth, noiseless action of gears, (two teeth always having two points of contact in the plane of axis); (2) great strength, therefore minimum bending action of the load; (3) elimination of back lash; (4) large power capacity through comparatively small gears; (5) high peripheral speeds and abolition of end thrust; (6) space conservation and low power consumption; (7) long service, due to minimum of



800 H.P. silent chain drive enclosed in an oil retaining steel casing. An oil pump is used in connection with a drive of these proportions.

friction and vibration and (8) the ability to carry heavy overhung loads.

Open Gearing

This method as a direct connection and speed reduction arrangement between motor and driven equipment is practically obsolete, because of its inferiority to the modern rigid and flexible methods. Its use is now almost solely confined to secondary reductions, since by this means a lower ratio reduction unit can be employed. Cut tooth open gearing is extensively employed for integral mechanisms of machines and for heavy loads at slow speeds.

Combination of Systems

Because of the compactness of certain methods of both the flexible and rigid systems and their adaptibility to each other, it is frequently necessary and also possible to combine them for one installation. The usual requirements are speed reduction coupled with speed variation, flexibility coupled with rigidity, and a first cost economy, based on the possibility of avoiding a concentration of the entire velocity ratio in one unit of the installation. In industrial driving a combination of methods is not unusual in view of complicated demands and limited space.

Efficiency and First Cost Comparison

Basis—25 Hp. 900 R.P.M. Motor—Ratio 40 to 1	
Worm reduction unit—eff. 80 per cent—First Cost	$ 750.00
Spur gear reduction unit—eff. 84 per cent—First Cost	425.00
Herringbone reduction unit—eff. 95 per cent First Cost	560.00
Vertical motorized unit with standard open squirrel cage motor—eff. 96 per cent—First Cost	1150.00
Horizontal motorized unit with standard open squirrel cage motor—eff. 96 per cent—First Cost	1000.00

Acceleration of Heavy Inertia Loads

Probably the greatest problem to be contended with in modern mechanical power application by any method is the gradual acceleration of heavy inertia loads or what is commonly termed "high starting torque." The force required to translate a body from a state of rest to one of motion depends upon two factors—the weight or mass of the body and the rate of acceleration. This law applies to bringing machinery into motion as well as to moving an object along a straight line path. The force necessary to set a body into motion is termed

V-belt drive to a bullard mill.

"accelerating force" and the twist required to start and bring machinery to full rotating speed is termed "accelerating or starting torque". Starting torque must be applied gradually to avoid abuse or destruction to the driving mechanism and the driven equipment involved.

Direct connecting a motor to a load, particularly where high velocity ratios are concerned necessitates methods of the rigid system. Because of the absence of mechanical slip with such methods, the motor is required to come to full speed under the applied torque, and if severe, destructive strains are set up in both the driving and driven equipment, unless relieved electrically or mechanically. It is economically desirable, wherever possible to employ standard induction motors with "across the line" start, thus permitting the motor to come to full speed or torque in a few seconds. If the applied load is heavy and the motor is of the squirrel cage "across the line" start type and rigidly or flexibly coupled, the motor must come to full speed under the load torque, unless relieved by the substitution of a slip ring for a squirrel cage motor or by interposing a mechanical device between it and the load.

Expensive methods, such as slip-ring motors, etc., for overcoming high starting torque can be eliminated by a mechanical device, known as the "mechanical slip-ring starter". This unit can be employed as a direct connection coupling possessing flexible qualities or as an integral part of a pulley, sprocket, gear or sheave. By means of slipping friction, it automatically starts machinery smoothly and with absolutely uniform acceleration. This device is inherently a limit torque coupling; it will not transmit to the driven machine nor impose on the motor more than the maximum load for which it is designed. The duPont Co. now has 125 of these starters in operation ranging from fractional to 150 hp. because it enables them to rate motors at the running instead of the starting load of various equipment, because it permits the use of standard squirrel cage motors "across the line" started for accelerating heavy inertia loads and because it is a positive overload release in the event of a jamming or sticking of the machine being driven.

The ability to choose the correct mechanical transmission method is valuable to the industrial plant engineer and subsequently to his employer, since upon the choice depends to a considerable extent operating profit or loss. Profits to an industrial organization are internal as well as external, therefore as long as the importance of the mechanical link in the power chain from generation to application is disregarded by engineer and executive, it will continue to be a waster of money and power and a brake on production efficiency.

DISCUSSION

PRESENTED BY

L. F. COFFIN, Superintendent Mechanical Department, Bethlehem Steel Company, Sparrows Point, Md.

A. J. STANDING, Electrical Superintendent, Bethlehem Steel Company, Bethlehem, Pennsylvania.

N. C. BYE, Chief Engineer, Henry Disston & Sons, Inc., Philadelphia, Pennsylvania.

F. O. SCHNURE, Electrical Superintendent, Bethlehem Steel Company, Sparrows Point, Md.

R. W. FULLER, Consulting Engineer, Riverton, New Jersey.

C. R. HAND, Lubrication Engineer, Bethlehem Steel Company, Sparrows Point, Md.

A. T. HALSTEAD, Master Mechanic, Bethlehem Steel Company, Sparrows Point, Md.

C. D. WRIGHT, J. E. Rhoads & Sons Co., Wilmington, Delaware.

D. L. CHESTNUT, General Electric Company, Philadelphia, Pennsylvania.

C. ROYSTON, Master Mechanic, Bethlehem Steel Company, Sparrows Point, Md.

L. F. COFFIN: There is one phase of mechanical power transmission that has been much overlooked in the steel industry, this being the use of suitable breaking points. There are a number of standard couplings on the market having shear pins for this purpose and it appears that in the heavier drives, much study should be given to improve the breaking points so that in case of severe overload, only a relatively small amount of damage will be done. I believe that there is a tendency to give this matter much more thought than has been the case in the past. The use of single helical drives is increasing in steel mills, especially on main drives, one of the advantages being less tendency to "hunt" and more quiet running. Open gearing still has its definite place in certain steel mill applications where salt, water and other extreme conditions render the maintenance of closed gearing extremely difficult.

A. J. STANDING: I want to compliment Mr. Staniar on the paper, and to say it has been a privilege to sit here and listen to a paper as complete as has been Mr. Staniar's exposition of drives. I am looking forward to the time when I can look it over carefully and thoroughly digest it.

If I might be so bold as to add one division to the ramification of drives which he has cited, I might refer to the difference between drives of so-called emergency units versus continuous running units. Under the heading of emergency units I would place such drives as fire pumps, flood control pumps, powerhouse or auxiliary stand-by units, wherein I think the objective is to get the unit going as promptly and efficiently as possible, without any particular regard, or not much regard at any rate, to its noise, its vibra-

tion or its cost and efficiency while running because the units are inherently of a short-running duration period. We have been faced with several instances of this kind; for instance in our fire pump equipment the objective is to get the starting apparatus so adjusted that the unit will start immediately with as little delay as possible.

Another interesting case is the stand-by unit in the power-house or boilerhouse, rather, wherein we are contemplating driving from the turbine through a fan, which is normally motor driven. We hope to reverse this drive and drive from the turbine, with an auxiliary-driven generator which will maintain the generation for the stoker feed of the boiler house and at the same time drive the fan at the other end, idling the motor. In that case we are not particularly interested in the niceties of the drive, which Mr. Staniar has brought out very carefully; but we are interested particularly in getting the unit in service immediately with as little unnecessary motion as possible. By that I mean that we don't want these boiler tenders to have to throw three or four switches, and uncouple this and couple something else up; we want the unit to go on as promptly and simply as possible. And that, of course, is in direct opposition to the normal type of drive, as touched upon by Mr. Staniar, in which the various methods for an efficient drive are of primary importance.

I would like to refer to the growing application of the gear motor drive which has come into all industry and has filled a long wanted source of application of power and which I hope some day to see properly applied to cranes. Sooner or later, I think, we will have a gear drive on a series crane motor which will give us a compact, clean, easy-running trolley.

Another type of drive which has interested us a great deal has been the drives of grinders. There we have recourse to the V Belt, primarily, but they always have the ever-increasing demand for dynamically balanced motors. To those of us in the maintenance end of the steel plant, where dynamically balanced motors are not an every day occurrence, the demand of the grinder people for dynamic balance is a question; provided we rewind the motor, or repair it, how are we going to arrive at the dynamic balance which is considered so necessary– And if they have recourse to V Belts, why are they so insistent upon dynamically balanced drives?

The question of V Belts versus chains, silent chains, was brought very forcibly to me in an interesting application of a precision mill. The precision mill is equipped by a vertical drive on the finishing stand. The precision mill drive motor is actuated from a generator mounted on the base of the main motor, which generator was driven from the shaft of the main motor so it would always be in step with the speed of the main motor. At least, we thought it was going to be in step. We ran into quite a considerable amount of trouble, until we finally traced it to slippage due to the V Belts. After quite a lengthy argument the V Belts were replaced by chain drives and we have had no more trouble with the generator getting out of step.

I want to take this opportunity of thanking Mr. Staniar and I am going to read his paper with a great deal of interest.

N. C. Bye: I wonder if Mr. Stanier would touch briefly on some of the coupling troubles that might be had between the different types of gear reductions such as herringbone, spur gear, and single helical gear. These troubles are those which come due to the ability of the spur gear to allow the motor to hunt, and the inability of the herringbone gear to take care of that same condition.

I would also like to ask what position the V-flat drive has in the transmission picture. Is it a makeshift or a recognized drive?

R. W. Fuller: Mr. Staniar's paper has been of considerable interest to me. I don't have any two hundred million dollar laboratory, or a steel plant, to experiment in.

I think Mr. Staniar's paper is an extremely valuable index to who ever is interested in mechanical power transmission. For myself, I am going to reinforce it with a copy of Mr. Staniar's handbook.

I would like to ask Mr. Staniar what he believes the difference is in the relative advantage of the short center drive with the pivoted base, of the V Belt as against the flat belt. I have just had occasion to install a 75-horsepower motor on an ammonia compressor, where I wanted to belt drive; capital was very limited. I found in this particular case that a flat belt drive, on practically the same center line, or close enough to it, had the same or equal guarantees, so far as efficiency is concerned as could be obtained with the V Belt drive and actually at less price.

Now, I would also be interested, if it is possible—and I don't know whether it is possible to diagram it—if Mr. Staniar would tell us a little more about this English drive, the Wearn Auto-flex drive. I didn't quite grasp the full idea of the installation.

F. O. Schnure: I enjoyed Mr. Staniar's paper very much. I was rather surprised to hear him classify the chain drive as a resilient type of drive. We have gotten ourselves out of trouble in a number of cases on drives ranging from 25 to 100 horsepower where the vibration or the shock of the driven load was reflected back into the motor, causing motor failures and motor troubles, by applying the V Belt drive to those particular jobs. Moreover, we did have an alligator shear, which had a chain drive and on this job, we couldn't keep a motor more than a month or so at a time. It had good control, had a flywheel on it, and there was no indication that it should give trouble, but it simply did. We cured it by installing a V Belt drive. That motor now stands up year after year without trouble, and it struck me that the chain drive wasn't sufficiently resilient for many such jobs.

C. R. Hand: I was certainly well pleased with Mr. Staniar's paper.

There is one point, however, on chain drives, that should be stressed. Chains are not a cure-all for transmission troubles. Various types are marketed and used. The many moving parts of chains are sub-

jected to wear and stretch. Abrasive dust must be prevented from adhering to the chains and sprockets and proper lubrication must be obtained. Heavy shock starting and stopping should be avoided.

The problem of lubricating a chain, particularly at high speed, is one of the most difficult and each drive must be treated as the operating conditions demand. The lubricants used will depend on speeds almost entirely. Heavy lubricants cannot be used in some types, due to the small parts, at any speeds.

A. T. HALSTEAD: Well, I certainly have enjoyed Mr. Staniar's paper. On this business of chains, we haven't had a whole lot of experience with it, but I was just wondering, on the chain drive which is totally encased, what effect they have where you have a forward action and reversing every few seconds.

C. D. WRIGHT: It has been a real pleasure to have listened to Mr. Staniar's paper this evening and I congratulate you gentlemen on the splendid meeting you have had, and the interest your members have taken, and the questions asked Mr. Staniar show that correct mechanical transmission methods are important and necessary in successful plant operations.

D. LEE CHESNUT: There are two questions I should like to ask Mr. Staniar. In the use of the word "efficiency", in comparing the V Belt and flat belt, is the speaker thinking of efficiency in terms of power loss, or speed loss?

And the other question: I was a little surprised to hear the statement of an average life of six years for well-selected mechanical drive equipment. I wonder if that is influenced by the atmospheric conditions of his particular industry, or is that an average figure that he would project for the steel industry as well?

C. ROYSTON: I have certainly enjoyed the paper very much. I might say that, very recently in our coke plant at Sparrows Point, we installed a V belt drive that has eliminated a lot of grief that we previously had.

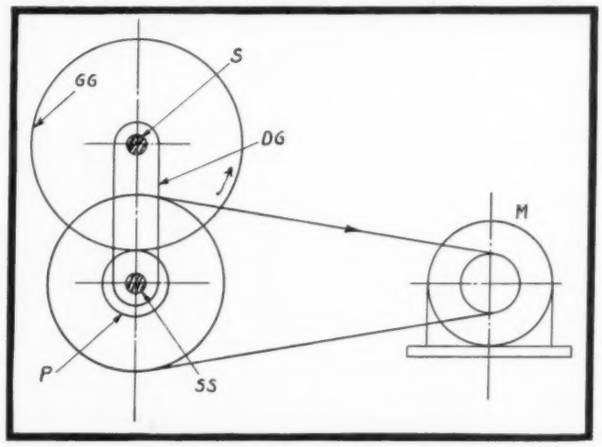
WILLIAM STANIAR: I have tried to memorize the questions but if I miss any of them, I trust the stenographer will assist me.

I believe the first question, in fact, a great many of the questions dealt with chain drives. It was not my intention to imply that a chain drive is a panacea for all evils. I tried to bring out particularly its attributes and the points favoring its use in process plants, over the V-belt. I believe the first question was in connection with dust or abrasives getting into the casing and attacking the chain, and the trouble experienced due to poor lubrication of the chain. I do not know whether these gentlemen have had experience with the latest types of oil retaining casings, and the latest developments in silent chains. My remarks have been based on the latest types. I will cite an experience at our Baltimore Plant, where there is in operation a 450 horsepower silent chain drive under very severe abrasive conditions. The chain is driving a mill grinding ilmenite ore which is, when ground, practically an emery, and due to a non-sealed type of apparatus, the atmosphere is permeated with ilmenite dust. This chain drive has been operating twenty-four hours a day for the past two and a half years, and has not been removed from the casing; in addition the motor has not had to be moved back due to chain pitch elongation.

The latest oil retaining casings are absolutely dustproof and they lubricate with high efficiency, provided the lower strand of the chain is not immersed more than $\frac{1}{8}$" to $\frac{1}{4}$" below the level of the oil. That is one of the greatest troubles with the lubrication of silent chain drives—the user does not realize that $\frac{1}{8}$" to $\frac{1}{4}$" immersion is sufficient. In many cases, I have found chain drives running totally immersed in the oil. Such a condition causes foaming of the lubricant and, therefore, very poor or practically no lubrication at the pins and joints of the chain. At room or operating temperatures of 40 to 100° F. and oil of 500 to 700 Sec. S. U. V. at 100° F. should be used for enclosed silent chains.

The chain drive is an absorbent of shock, but it has not the cushioning effect of the V-belt. However, due to a multiplicity of parts, it is shock absorbing. That point was brought out by the discussion of an actual experience given in my paper. Rapid reversal or heavy shock starting or stopping is injurious to silent chains.

One gentleman asked me about the Wearn Autoflex. Diagramatically, as illustrated above, this is the principle of the Wearn-autoflex drive. The motor is at (M), the pinion (P) is supported on a shaft, which is hung by



Wearn Auto-flex Drive.

one or two pivot castings, (DG) on each side of the driven gear. (S), is the driven shaft. As the load is applied to the floating shaft (SS) the pinion (P) makes an epicyclic movement, on the (GG) gear, automatically tightening the belt from the motor.

Under no load the fulcrum or pivot casting hangs vertically. The moment the load is applied, one, two, or three tooth movement of the pinion on the gear is apparent. Whether this drive will become popular, is difficult to say. The Sprout-Waldron Company (Muncie, Pennsylvania) are the American licensees and for the past year they have been experimenting, prior to placing it on the American market.

There was one question asked, I believe, about flat

belting on short centers—I presume that the gentleman meant with the motor merely on a slide rail.

You will obtain more efficiency with the flat belt, provided it is of the correct type, with the pivoted motor base, than you will obtain with the V-belt. With proper adjustment of the pivoted motor base and a proper belt, a good drive will result. The distance, however, from the pivot shaft on the base to the center of the motor must be correct for the power, speed, and ratio requirements.

A question was asked about the six year span of life of transmission equipment. That figure is based upon my experience in the duPont Plants. We are a chemical company, and naturally, our atmospheric conditions are much worse than those in the steel industry. Even a correctly installed speed reducer, if it is running in some of our chemical plants, will show signs of deterioration in six years.

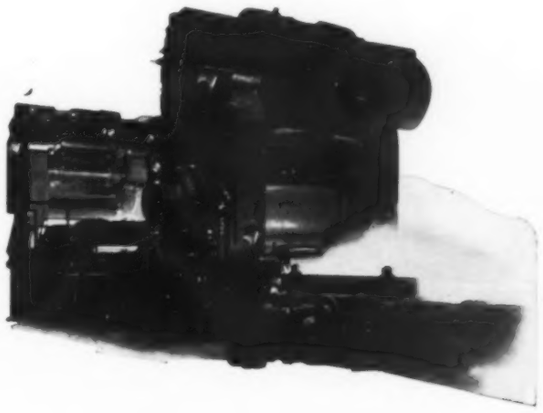
Another question, I believe, was about the V-flat belt drives. We consider the V-flat belt drive as an emergency proposition, or where it is desired to change a drive from a flat belt to a V-belt with the least cost; but we do not consider them for new drives. They are, however, quite efficient. I have not had more than two cases in the last two years where I have used V-flat drives. For low cost and quick installation I feel they are all right.

Regarding couplings, likely I would use, with a spur gear unit, a flexible coupling known as the "torsional resiliency" type, which will allow a certain cushioning effect.

With the herringbone unit I would use any good grade or standard flexible coupling. We use the Fast flexible coupling above 25 horse power on such installations. If I want to use a torsional resiliency coupling that will take a shock and tend to cushion any effect of the spur gears, I lean toward the Brown cantilever flexible coupling. The Francke coupling will furnish a slight cushioning effect, due to the laminated construction pins.

The question was asked as to whether my efficiency ratings were based on speed or power. Efficiency ratings are always based on the relation of power input to power output.

If there are no further questions I desire to thank you gentlemen very much for your attention and, again, to assure you that it has been a great pleasure to present a paper that has been so well received, particularly when I was a little worried about delivering it.



PORTABLE CRANE TRUCK DESIGNED

▲ "PORTABLE Crane Trucks," Elwell-Parker's newest addition to its technical bulletin file, describes the four types—CK, CU, CX and CZ—ranging in capacity from 1,000 to 10,000 pounds. Each has a 2-wheel drive (22″ x 6″) and a 4-wheel steer by means of a wheel. The entire mechanism is compact and so engineered as to provide maximum forward vision for the operator. Arrangement of cables from hoisting unit to boom and hook is direct and simple.

Portable crane truck with a two wheel drive and four wheel steer.

Boom lengths are available according to operating requirements. Standard length boom is telescopic and may be adjusted to any outreach from 12 to 19 feet. Other lengths of 8 to 35 feet are telescopic or fixed booms. Electric magnets may be supplied on these booms.

The power plant is equipped with Elwell-Parker heavy duty motors, 500% overload. All parts are easily accessible and design is such as to permit crane to travel uneven ;floors without transmitting strains to mechanism. Cranes are driven by either battery or gas motor and electric generator carried on frame and acting as counterweight for load on hook.

In its crane series, as in other Elwell-Parker equipment, the Company has emphasized safety to men, machine and loads. As an illustration, dynamic brakes supplement the travel brakes, and provision is made for outriggers which under certain circumstances contribute an additional Safety Factor.

Each Crane bears the Underwriters' Seal in testimony to the maker's successful effort to guard in advance against personal injury, loss or damage. Bulletin furnished on request by Elwell-Parker, 4205 St. Clair Ave., Cleveland, Ohio.

ALLOY COMPANY ACQUIRES BUILDING

▲ STANDARD Alloy Company, Inc., of Cleveland, has acquired the site at 1679 Collamer Road, where it has been located for the past ten years. The property, which comprises four acres, is improved with three buildings. Standard took over the larger of two brick-and-steel structures about two years ago. Steady growth has rendered this forward step advisable, according to F. F. Jackson, secretary. Standard manufacturers heat-and corrosion-resisting castings, specializing in nickel chrome alloy.

IMPROVED DESIGN OF COUPLING

▲ AN improved design of flexible coupling is offered by the Falk Corporation under the trade name "Steelflex Couplings". This design uses the basic principle employed in previous designs of Falk Flexible Coupling based on shock absorption and compensation for misalignment through the action of a resilient grid member. Details of design have been improved through the use of symmetrical design on both the driving and driven hubs, the use of a symmetrical design on the halves of the coupling cover which protect the operating elements and act as a grease reservoir for the coupling lubricant. The openings between the shell and the coupling hubs are effectively sealed against leakage of lubricant as well as the entrance of dirt or foreign material through the use of moulded Neoprene seals. The forty page Falk Steelflex Coupling Bulletin, No. 4100, describing the new FA series has just been announced. This bulletin covers specification, design, rating, method of selection, and dimensions. It also contains a very interesting section of installation photographs.

The FA type Steelflex coupling is available in ratings from 14 HP to 18000 HP. All commercial sizes are available for stock shipment and arrangements are being completed to make the coupling available in distributors' stock in all important industrial centers.

WEST COAST MILL STARTS PRODUCTION

▲ THE recently organized West Coast Steel Company has started production at its plant at south San Francisco, Calif. The company rolls bars, light structural steel and light reinforcing steel from scrap steel rails. The officers are C. B. Runkel, president; L. S. Runkel, vice president; and William Tynan, secretary and treasurer.

THREE-HIGH MILL FOR COLUMBIA STEEL

▲ COLUMBIA Steel Company of California has awarded Lewis Foundry & Machine Company, a Blaw-Knox Company subsidiary, a contract for a completely mechanized three-high mill with roller and catcher tables. This is the seventh three-high mill order received by the Lewis Company this year.

INSULATING BRICK ON FURNACES

▲ TWELVE of the modern types of industrial furnaces for which the new JM-20 Insulating Brick has been developed are illustrated in a new piece of literature entitled, "Lower Furnace Operating Costs With Johns-Manville JM-20 Insulating Brick". These furnace drawings show clearly the application of this new insulating brick to each of the twelve different types.

One of the most useful features of this literature is a table giving the heat losses transmitted through fire brick walls bare and through fire brick walls insulated with JM-20 Brick. This table includes data on 27 different furnace wall constructions, representing virtually every practical combination of refractory and insulating brick.

Also defined are the physical properties of this brick, which is designed for use behind refractory walls in furnaces and other types of high temperature industrial equipment or for direct exposure at temperatures up to 2000 degrees Fahrenheit wherever there is no flame impingent, slag action, or mechanical abrasion.

Copies are available free upon request to Johns-Manville, 22 East 40th Street, New York City.

THREE NEW MILLS FOR ENGLAND

▲ MESTA Machine Co. has received a contract for a new blooming mill, a hot strip mill and a cold strip mill together with all necessary equipment from John Summers & Sons Co., of England.

The new mills will be installed at Shotten, near Liverpool, and Mesta Machine will have entire supervision of construction.

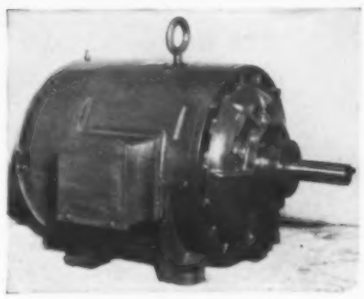
Lorenz Iversen, president of the company, in confirming receipt of the contract stated operations are at capacity and there is more business in Mesta's books than ever before in its history.

NEW FAN COOLED TYPE MOTOR

▲ PROTECTED against abrasive dust, moisture and corrosion, a new design of dual ventilated fan cooled type CS squirrel-cage motors has been announced by the Westinghouse Electric and Manufacturing Company. Designed for use in automobile factories, foundries, cement plants, coal timples, machine shops, steel mills, chemical plants, dye houses, tanneries, packing plants, etc., where severe service is required. They may also be installed outdoors without additional protection.

The motor frame contains two separate sets of air ducts, one set internal and one set external. The internal ducts are open in the interior part of the motor and the external ducts are open on the outside of the motor frame. These two sets of ducts are separated by a common wall.

The heat exchanger principle is used for cooling. An internal fan on the rotor circulates warm internal air through the internal ducts, the walls of which are cooled by the external fan blowing larger volumes



New type dual ventilated fan cooled type squirrel-cage motor.

of cool air through the external ducts, providing rapid transfer of heat from the motor, insuring long insulation life.

The housing is designed so that fresh grease enters the outside edge at the top of the bearing and excess or used grease is discharged at the bottom inner edge to the overflow sump. Since adding fresh grease automatically cleans the used grease from the bearing, it is unnecessary to incur the expense of periodically dismantling the motor to clean the bearings. The used or excess grease may be readily removed from the overflow sump through a pipe plug opening. The cartridge type bearings are fully protected when the rotor is removed.

NEW OFFICE FOR McDONALD MILLS

▲ A one story addition, 53′ x 74′, to the office building at the McDonald Mills of Carnegie-Illinois Steel Corporation, has just been completed for housing the order and shipping billing departments for the finishing mills in the Youngstown area.

The addition has steel framing with brick outside walls to match the original building, and the floor is concrete with asphalt tile covering. The partitions, window sash and roof deck are made of steel.

This addition permits the centralization of the order and shipping billing departments, and will facilitate the scheduling of mills.

Office space left vacant by the transfer of this department later will be occupied by the industrial relations and compensation and pension departments.

PHOTOELECTRIC INSTRUMENT DEVELOPED

▲ A photoelectric instrument which will record simultaneously on one chart, two electrical quantities as low as one microampere, full scale, and representing a power consumption of but 0.000000001 watt from the measured circuit, has just been placed on the market by the General Electric Company. It is designated the double photoelectric recorder.

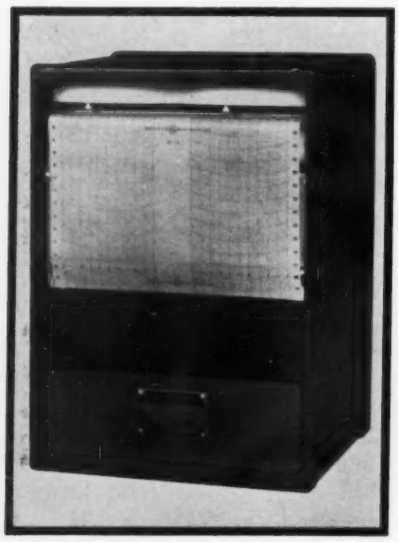
The double photoelectric recorder can be applied wherever simultaneous readings are desired. In some cases this immediately cuts testing time in half and in others it aids materially in discovering unusual relations between two variable electrical quantities. This recorder is the outgrowth of the original photoelectric recorder which has become familiar to electrical and mechanical engineers, physicists, and others, including physicians, and scientific crime-detection specialists.

With the original photoelectric recorder, many applications to the measurements and recording of electrical and mechanical quantities have been made. The only requirement is that the measuring element needed in the recorder must be capable of rotating a small galvanometer mirror. By means of an optic and photoelectric system, and power circuit, the measuring element causes the recording element to follow its movement.

The double photoelectric recorder came into existence because of a demand for an instrument that could measure and record the surface irregularities of steel strips. This meant that two photoelectric recorders and two electric gauges would be required, one gauge on each side of the strip and directly opposite one another. Both records should appear on the same chart so that they could be checked quickly and accurately. The two recorders were therefore combined in a single enclosing case and called the double photoelectric recorder. A standard chart mechanism was extended to accommodate a 10-inch chart paper, and the chart mechanism either driven in the conventional way or from an external drive.

The double recorder can be applied for many other measurements. For instance, in temperature recording, it is possible to record outdoor and indoor temperatures for air-conditioning work, wet- and dry-bulb temperatures, refrigeration temperatures, and other temperatures in heat-flow problems. Galvanometer-type recorders can be supplied for physiological studies such as the simultaneous recording of skin temperature and finger volume, and comparative temperatures of the human body. In the field of electric gauging, it is of increasing importance to have simultaneous recording of pressure, as obtained by a strain gauge on the mill housing, and thickness as obtained by the continuous strip gauge. At a glance it is possible to see variations in thickness with changes in pressure on the mill rolls. With two continuous strip gauges, one on each side of the material, a measurement of uniformity in thickness of the strip is obtained and therefore a measure of quality. Electric-gauge recordings can be so related that a continuous check on operating conditions, such as poor bearings and rolls, is at hand. Other applications are the recording of high-resistance voltmeter-ammeter measurements, illumination measurements, and others requiring galvanometers or other types of measuring elements.

Photoelectric instrument capable of recording two electrical quantities as low as one microampere.



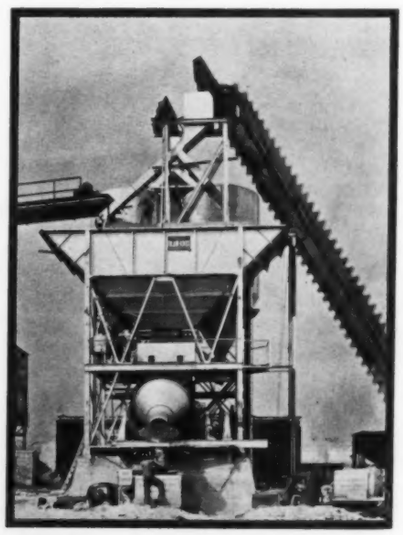
TRANSFORMER BULLETIN

▲ THE Pennsylvania Transformer Company, Pittsburgh, Pa., announces bulletin No. 340 which deals with power and distribution transformers, and contains photographs of various large Pennsylvania Transformers, single phase and three phase, used for power transmission, for electric arc furnaces, for railway systems, and for other industrial uses, and describes, briefly, a few of the important developments and improvements in Pennsylvania transformers, such as its uni-row radiators, straight line tap-chambers, circular coils, etc., with one section of the bulletin devoted to improvements in distribution transformers.

MIXING PLANT FOR MILL CONSTRUCTION

▲ COMPLETE Blaw-Knox central mixing plant, as illustrated below, serving the Birmingham Slag Company in the handling of some 108,000 yards of concrete used in the construction of the new $30,000,000 hot and cold strip and plate mill for the Tennessee Coal, Iron & Railroad Company, at Birmingham, Alabama. In addition to the mixing plant, there are 10 Blaw-Knox trukmixers being used to facilitate the handling of 60 yards per hour on some pours. The batching cycle for the cement is approximately 15 to 18 seconds.

Central mixing plant used in steel mill construction work.



FIRTH-STERLING STEEL COMPANY OPENS NEW PLANT AT McKEESPORT

▲ THE largest plant in the world devoted exclusively to the production of sintered carbides—a tool material second only to diamonds in hardness—has been completed by the Firth-Sterling Steel Company at McKeesport, Pa.

The building bears no resemblance to the typical gaunt steel plant. Surrounded by a garden, the structure is distinctly modernistic in design, and such decorative materials as glass brick, plate glass, stainless steel, and aluminum have been used in its construction.

The entire plant is in keeping with the product, which might be regarded as the "jewelry" end of the steel business, as sintered carbides sell for $200 to $400 a pound.

So carefully must the cleanliness of the materials which go into the making of Firthite and Firthaloy be controlled that the interior of the building provides even more surprises than the exterior.

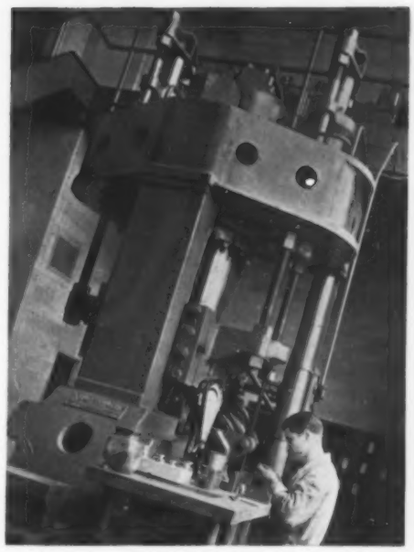
Some rooms have terrazzo floors, Carrara glass walls, and linoleum ceilings, so that every surface may be washed to eliminate the possibility of any foreign matter which would cause defects in the finished tools. A dust filtering ventilation system has been provided as a further precaution, and provision has been made for the future installation of an air conditioning system.

One room, which houses the ball mills where powdered materials are crushed and mixed, has been soundproofed to bring about an 85 per cent reduction in the noise resulting from the operation. Throughout the plant, every possible means has been used to provide pleasant working conditions and to insure cleanliness of the products.

While the development of sintered carbide tools is quite recent, they are playing an increasingly important part in the production of many of the products which are commonplace in our daily lives.

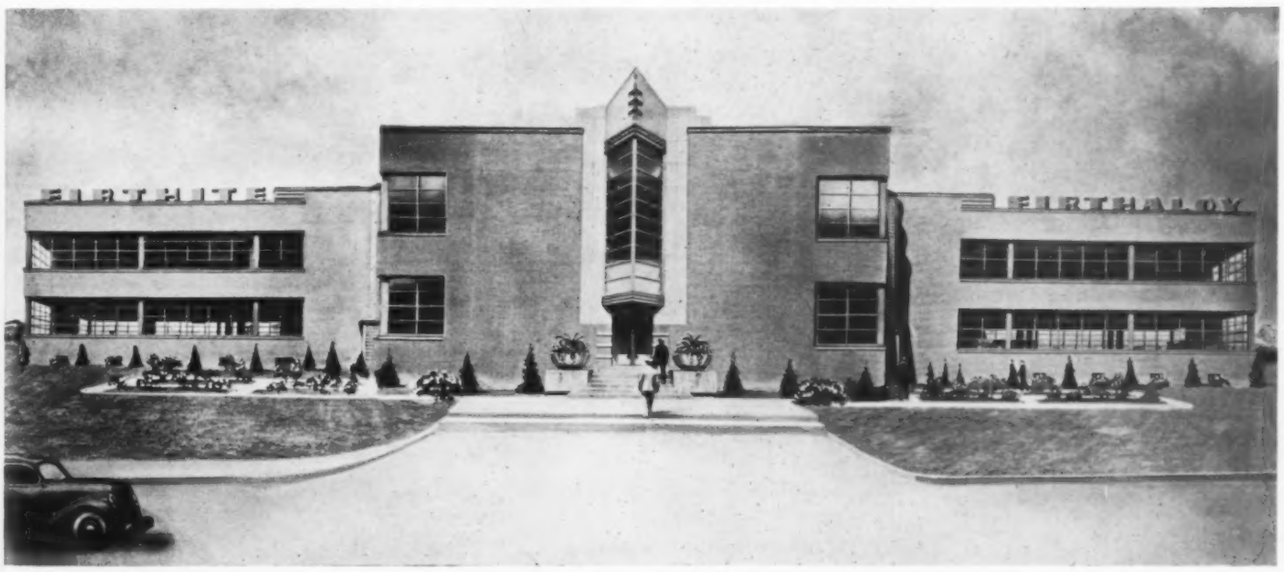
The extreme hardness of carbide tools has made it possible for industry greatly to increase production in many types of machining operations. This has been accompanied by rapid replacement of old machines with new equipment capable of taking advantage of the extreme speed and depth of cuts which can be attained with these modern tools.

Sintered carbides are made from extremely fine metallic powders of tungsten, carbon and cobalt mixed together, pressed in a mold to form a blank or tip, then heated in a hydrogen furnace to a temperature where the metal with the lower melting point softens while the others retain their solidity. The plastic metal then coalesces with the solid particles and on cooling the mass becomes a solid hard metal piece of a predetermined shape.

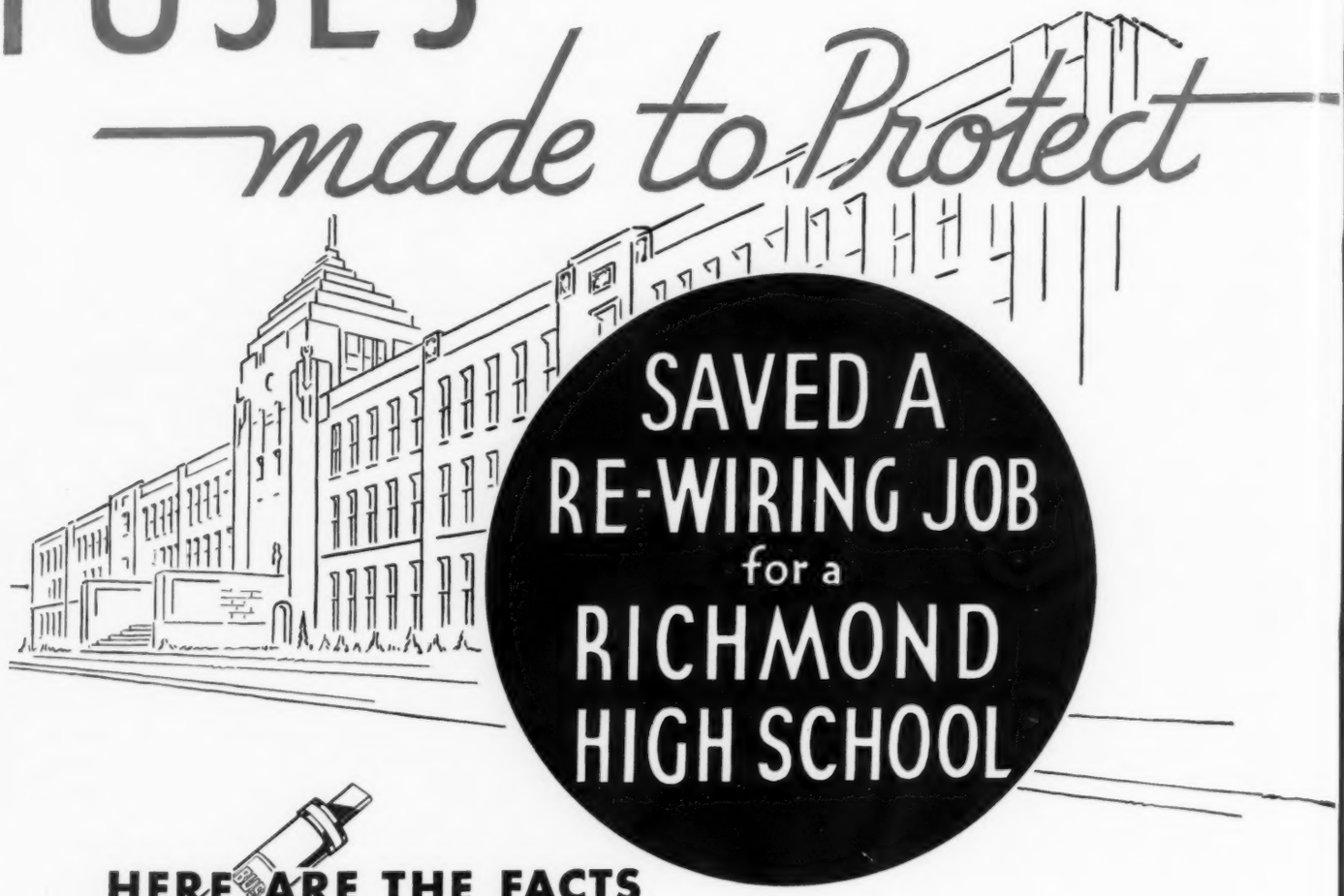


A view of the 400-ton two-way press where powders are compacted into the shape approximately 20 per cent larger than the finished blanks or nibs. Pressures range from 4,000 to 60,000 pounds per square inch of surface.

Front view of the new Firthite Firthaloy Plant.



FUSES *made to Protect*



SAVED A RE-WIRING JOB for a RICHMOND HIGH SCHOOL

HERE ARE THE FACTS

SAYS Mr. Morris Hunter, ***Electrical Contractor of Richmond, Va.***

"When the school was completed it was found that the 100 ampere fuses on the vacuum cleaner circuit would not hold the motor starting currents.

"Faced with the possibility of pulling out the conduit, wire, switches and fuses and to replace them with material of a higher capacity the school authorities decided to call me in on the job. I suggested that BUSS super-lag fuses be installed. This was done.

"There has been no further trouble with fuses blowing on starting currents and the cost and inconvenience of a mean re-wiring job was saved."

. . not to Blow!

you too, can SAVE TIME AND MONEY BY PREVENTING SENSELESS SHUTDOWNS *caused by* NEEDLESS BLOWS

Thousands of executives who once thought such waste was a necessary evil have found that there is literal truth in the saying that BUSS fuses are "Made to protect—not to blow."

To them BUSS fuses have proved a boon. Senseless interruptions of operating schedules caused by needless blows have been eliminated. Better protection has been given equipment—for BUSS fuses permit fuseing nearer to the load. On new installations considerable money has been saved for, as in the case of this Richmond High School, it is often possible to use smaller size switches or fuse blocks when BUSS fuses are installed.

Obviously there are definite reasons . . . .

GET THE FACTS

All set forth in easy to read style in the BUSS book on "Fuses made to protect—not to blow."

You will quickly see how BUSS fuses protect your pocketbook in two ways.

1. By safeguarding equipment, plant and persons against electrical hazards—

2. By preventing wasteful interruptions of operating schedules—due to needless blows.

Your name and address will bring your copy by return mail.

BUSSMANN MFG. CO.
University at Jefferson, St. Louis, Mo.
Division of McGraw Electric Co.

BUSS super-lag fuses are available thru Electrical Wholesalers

WHY BUSS FUSES DON'T BLOW NEEDLESSLY

10 FEATURES in the design of the FUSE-CASE help make it possible . . . . *and*

The **SUPER-LAG** development in the FUSE-LINK completes the job.

BUSS *Super-Lag* FUSES

CARNEGIE-ILLINOIS BREAKS GROUND FOR NEW IRVIN WORKS—W. A. IRVIN, B. F. FAIRLESS SPEAK

▲ CONSTRUCTION of Irvin Works atop Camden Hill "is probably the first installation of a major plant upon the top of a hill," B. F. Fairless, president of Carnegie-Illinois Steel Corp., said, on May 22, at the formal ground breaking ceremonies on the site of the new strip, sheet and tin plate plant.

"Successful operation" of Irvin Works" may well work a revolution in this district, so far as the location of new plants is concerned," he said.

The "twofold purpose" of the ceremonies, Mr. Fairless announced, was to dedicate the tract to "construction and operation of a large group of mills" and "especially to do honor and pay a richly deserved tribute to our distinguished guest," William A. Irvin, president of United States Steel Corp., "whose name this great plant will bear."

Preliminary work in construction of Irvin Works "involves a complete change of the surrounding landscape," Mr. Fairless said. The moving of 3,500,000 cubic yards of earth and pouring of 150,000 cubic yards of concrete for foundations were specified in the initial contract let early this week.

Speaking of the "enormous task" of construction, Mr. Fairless announced the group of buildings to house the plant will be 4,200 feet in length and 1,250 feet in width. The 600-acre tract "affords sufficient space for the duplication of the plant as now proposed," and he said, "it is our earnest hope that the day is not far distant when the entire tract will be used and occupied by additional mills."

The chief units of Irvin Works, "designed to meet the everchanging and increasing demands of the trade for flat rolled products," are, Mr. Fairless disclosed, an 80-inch continuous hot strip mill, an 84-inch three-stand tandem cold reduced sheet mill, a 42-inch five-stand tandem cold reduced tin mill and supplemental annealing furnaces, pickling and tinning departments. To be operated electrically throughout by motors of 300,000 installed horsepower and having an annual capacity of 600,000 tons, the plant's greatest importance, in Mr. Fairless' opinion, "lies in the fact that it is a long step forward in putting Pittsburgh abreast of the times in the production of sheets and tin plate by the cold reduced method."

Mr. Fairless said he took pleasure in studying the plans for Irvin Works, but derived greater pleasure in picturing "surrounding hills and valleys dotted with the happy homes of the men who will come here to operate these mills." Site preparation and construction will "provide employment for thousands of men," the speaker said, and when the plant is ready for operation, "the services of 4,000 regular employees will be required, and of this number 90 per cent will be skilled."

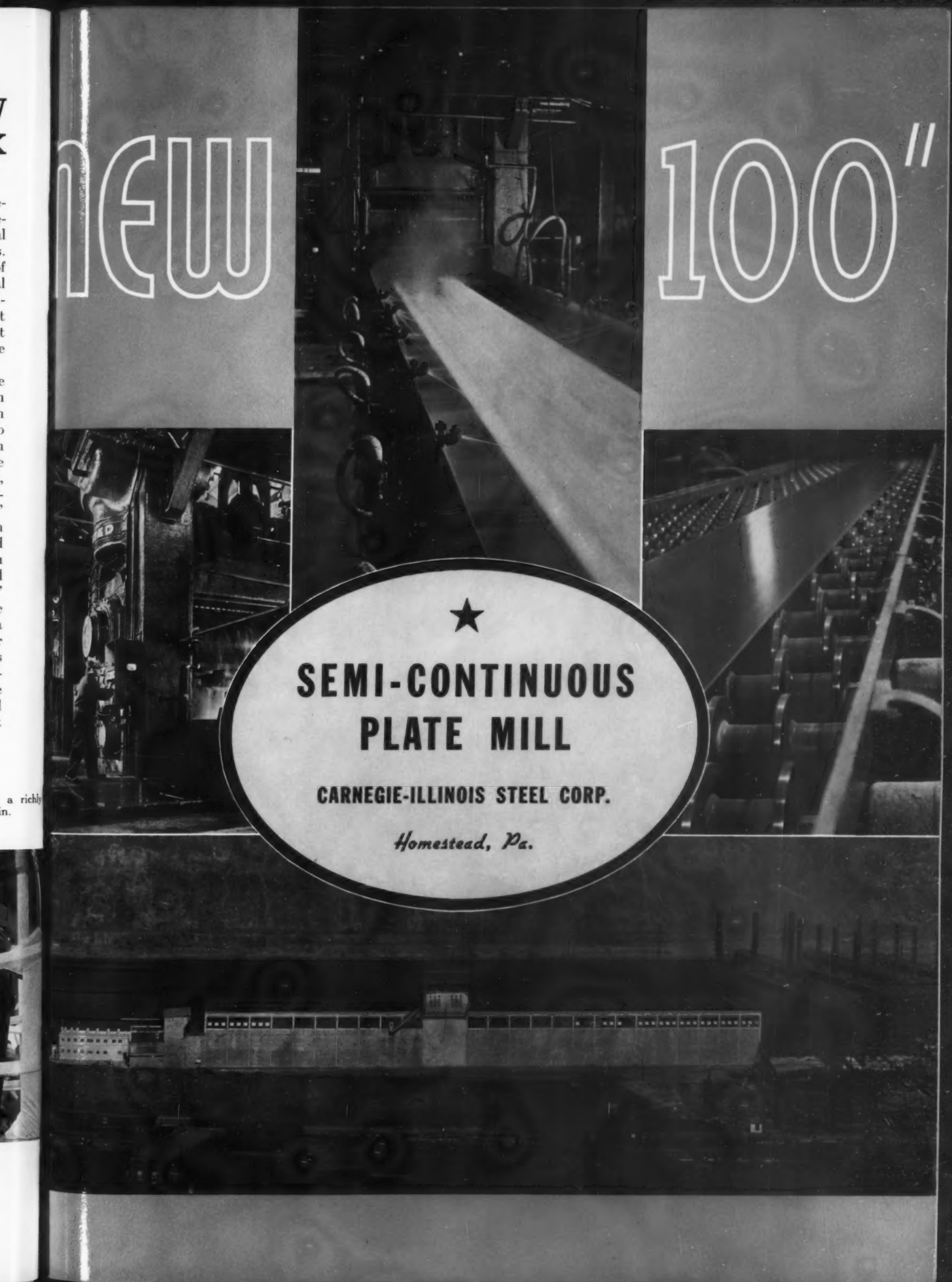
The Carnegie-Illinois president thanked Mifflin Township commissioners, school board members and other officials for their co-operation and assured them of the company's desire to "reciprocate by being a real neighbor and a desirable addition to this community."

Mr. Irvin, who spent many years of his business life in Pittsburgh, was introduced by Mr. Fairless as "a man who is well known to most of us and enjoys our respect and admiration." Speaking of Mr. Irvin's record, Mr. Fairless said, "His successful administration of the affairs" of United States Steel, "has made him an outstanding figure in the business world, and it is peculiarly fitting and appropriate that this great plant should bear his illustrious name."

W. A. Irvin addressing guests upon the occasion of the formal ground breaking ceremony at the Irvin works.

The first spadeful of earth being turned over by Mr. Irvin, with Mr. Fairless an interested observer.

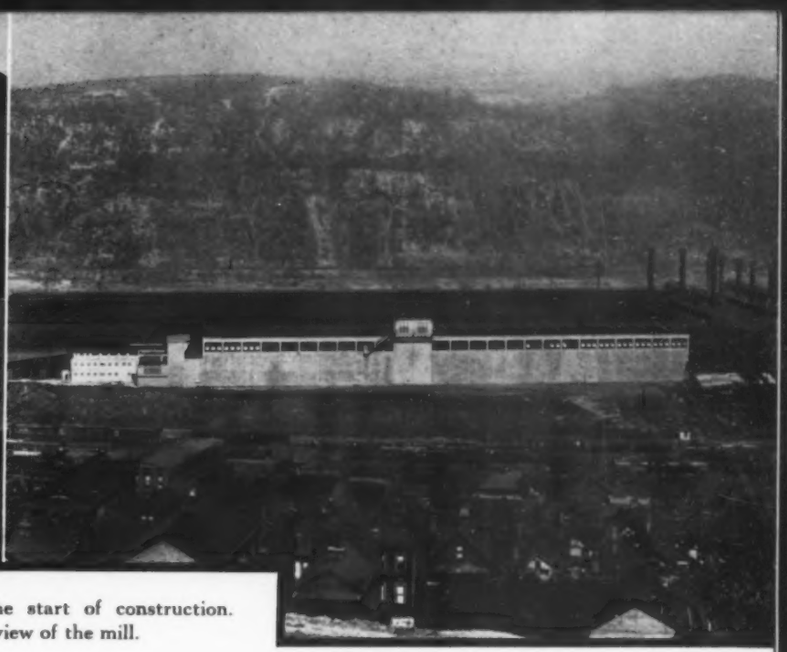
B. F. Fairless in his address paid a richly deserved tribute to Mr. Irvin.


NEW
100"
SEMI-CONTINUOUS
PLATE MILL
CARNEGIE-ILLINOIS STEEL CORP.
Homestead, Pa.

Benjamin F. Fairless

PRESIDENT

CARNEGIE-ILLINOIS STEEL CORPORATION



Left-Clearing site for the start of construction.
Right-General view of the mill.

New 100" Semi-Continuous Plate Mill

CARNEGIE-ILLINOIS STEEL CORPORATION

Homestead, Penna.

▲ TO meet requirements for high quality steel plates, accurate and uniform in gauge and width, with good surface, Carnegie-Illinois Steel Corporation built the Homestead 100″ semi-continuous plate mill. Into this mill, guided by the experience of years, have gone the best in standard practice, plus many new developments unique in this type of mill, and the smooth operation and high degree of production efficiency attained bear witness to the care exercised in its design.

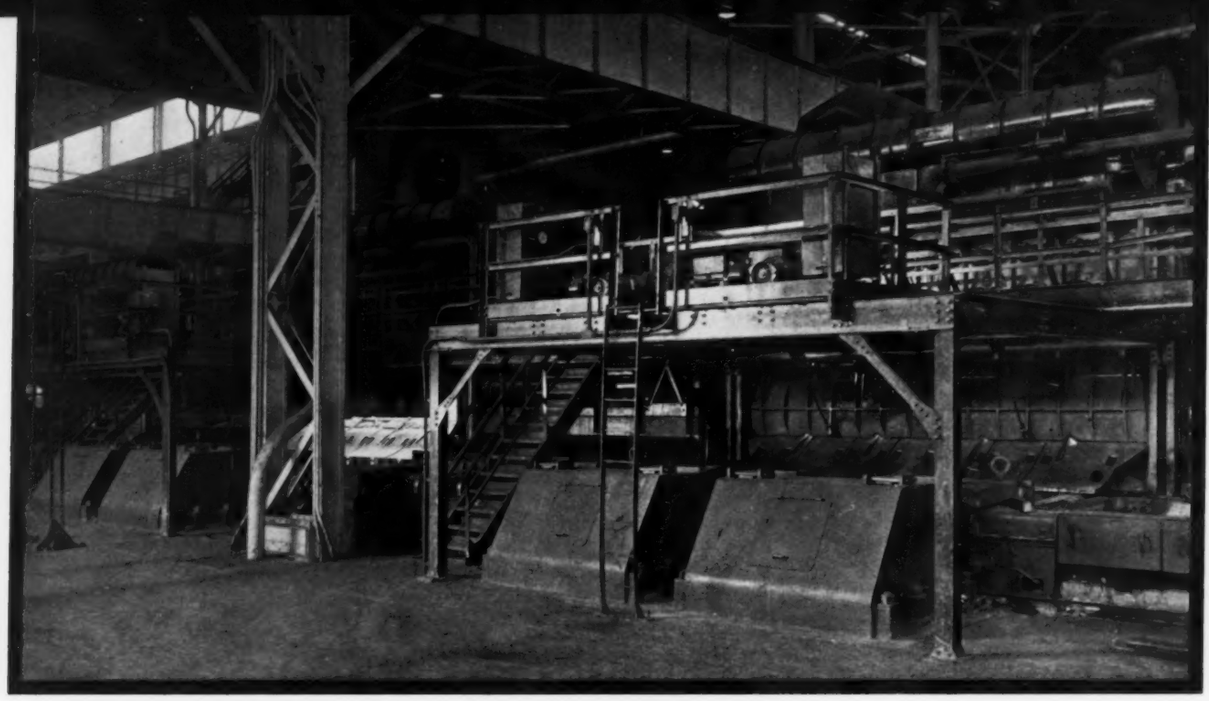
Excavation for this plant was started on Dec. 3rd, 1935, and rolling operations began on Dec. 1st, 1936. The project entailed 160,000 cu. yds. of excavation, 46,000 cu. yds. of concrete, 2,000 tons of reinforcing steel, and 6,400 tons of structural steel. Weights of mill stands, tables, shears, etc., totaled 14,200 tons, exclusive of electrical equipment. All buildings are floored with concrete, with wood block sections at points where men are constantly at work. Throughout the mill, excellent illumination has been provided. Buildings are designed to afford good ventilation. Forced draft unit heaters provide heat for the cold months.

The mill has a nominal capacity of about 60,000 tons of finished plate per month. Carbon steel plate, as well as some of the more common alloys, are rolled in widths ranging from 20″ to 90″, and in thickness from $\frac{3}{32}$″ to $\frac{5}{8}$″. Plate from this mill is uniform in gauge, accurate in dimensions, and free from shear bow, with a high quality surface finish.

FURNACES

Slabs for the new mill are furnished from the old slabbing mill at Homestead, and may range 22″–54″ in width, 3″–9″ in thickness, and 48″–180″ long. From the storage yard, which lies at right angles to the plate

General view with first reversing stand in foreground.



Three triple-fired continuous heating furnaces, 18′ wide x 82′–10″ in length, each with a rated capacity of 50 gross tons of cold steel per hour.

mill building, slabs, piled 6 to 8 high, are conveyed on a motor-driven roller table to the magazine feeder. The feeder in turn delivers one slab at a time to a roller table running across the charging ends of the hot mill furnaces. Each furnace is served by two motor-driven pushers, which may be used separately or in unison, so that slabs up to 7′–6″ in length may be charged in a double row, using the pushers singly, or slabs up to 15′ in length may be charged in a single row, with both pushers working together. Main furnace doors are motor operated, and are interlocked with pusher motors so that the pusher cannot be operated until the doors are open.

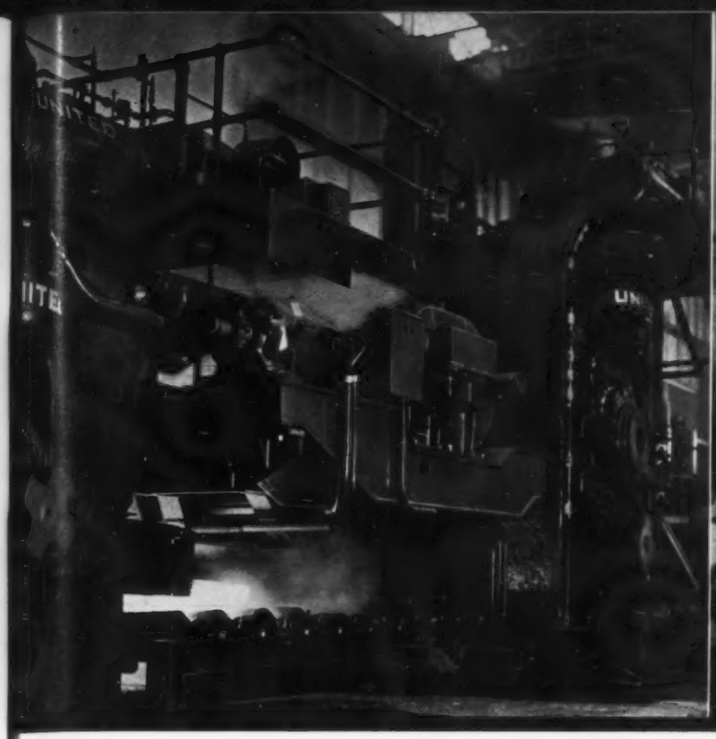
There are three triple-fired continuous heating furnaces, 18′ in width x 82′–10″ in length, including the soaking zone, each with a rated capacity of 50 gross tons of cold steel per hour. They are equipped with carborundum recuperators in which air for combustion is heated to 700–800 degrees F. They are completely insulated and steel-encased.

The furnaces are normally fired with by-product coke oven gas. Natural gas may also be used, or any mixture of the two gases. B.T.U. input to the furnace is automatically maintained, however, regardless of which fuel is used. Fuel-air ratios are also automatically controlled, as is furnace pressure. Automatic temperature control is provided and each furnace is also equipped with a 5-point temperature recorder, an indicating air temperature limit control, a recording gas flowmeter, as well as the various indicators accompanying the automatic control equipment.

Provisions have been made for the installation of a fourth furnace, should it be required.

Slabs being conveyed by means of a magazine feeder to the heating furnace.

Slabs being ejected into heating furnace by means of motor driven pushers.



(Top) Slab squeezer with a 7″ stroke and capable of a 3″ penetration on a 6″ thick slab.

(Left) Broadside mill in which slabs can be spread to a maximum of 96″ in width and 110″ in length in a single pass.

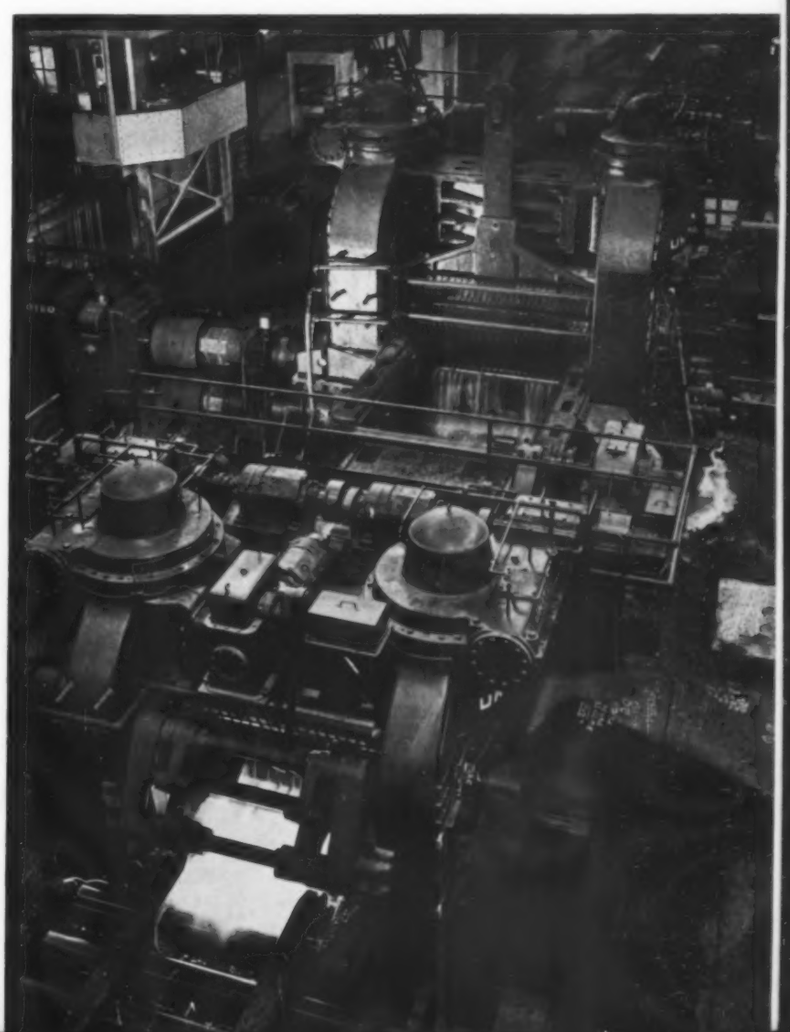
(Below) Scale breaker for cracking the primary scale. The scale is then removed by 1000 lb. pressure hydraulic jets.

HOT MILL

Hot slabs discharged from the furnaces proceed down a heavy-duty roller table, and pass through a 2-high 36″ x 100″ scale breaker, where a slight reduction serves to crack primary scale, which is then removed by 1000 lb. pressure hydraulic jets. The scale breaker operates at a speed of 190 ft. per minute, and is driven through a gear set by a 1000 H.P., 6600 volt, 500 R.P.M., 25 cycle A.C. motor. The next stand is a 4-high 42″ and 52″ x 120″ mill, operating at about 185 ft. per minute, and driven through a gear set by a 4500 H.P., 6600 volt, 370 R.P.M., 25 cycle A.C. motor. This stand is a broadside mill, in which slabs can be spread to a maximum of 96″ in width and 110″ in length in a single pass. A heavy-duty motor operated pusher on the entry side of this stand assures proper entry of the slab between the rolls. The broadside mill is proceeded and followed by specially designed slab turning rigs, which turn the slab through 90 degrees.

After passing through the broadside mill, the slab enters a squeezer, where it is flattened, and its edges and width trued and squared. This unit has a 7″ stroke, and is capable of a 3″ penetration on a 6″ thick slab. It is equipped with 16′ heads. The eccentric shaft is of forged steel, 26″ in diameter, with a 3½″ throw. The squeezer is driven by a 500 H.P., 500 R.P.M., 230 volt D.C. motor. Special care was exercised in the design of this slab reducer to avoid the possibility of upsetting on the slab.

The formed slab is next carried by two sections of roller tables, about 120 ft., through a second set of hydraulic descaling jets, to a 4-high, 36″ and 54″ x 100″ reversing mill, driven direct by a 7000 H.P., 700 volt, 40–80 R.P.M. D.C. motor. This stand is a unique feature of the plant, as it is the first large 4-high reversing hot mill ever installed in a tandem mill. A series of 3, 5, or 7 passes in this mill brings the slab to the desired size for finishing. Slabs may attain speeds as high as 754 ft. per minute through this stand.



M. F. McCONNELL
General Superintendent

ROBERT W. GRAHAM
Superintendent 100″ Plate Mill

W. E. CROUCH
Superintendent Plate Dept.

A 40″ x 10″ vertical edger precedes the reversing stand and serves to maintain constant slab width. It is driven by a 600 H.P., 700 volt, 125-406 R.P.M., compound D.C. motor, controlled in unison with the reversing stand.

Three sets of side guides serve this reversing unit, one preceding the vertical rolls, a second located between the vertical rolls and the horizontal rolls, and the third following the horizontal rolls. Side guides on the entry side of the mill are set to a dimension corresponding to the width of the slab being rolled, while those on the exit side are set four inches wider so as not to interfere with the steel leaving the rolls. These settings alternate according to the direction of the steel through the mill.

A special feature in connection with this stand lies in the fact that the control mechanism can be pre-set.

A. W. Soderberg, Chief Engineer, who, as illustrated, developed the new rocking shear from watching an old fashioned rocking chair. The curved blade principle eliminates shear bow or arch in plates.

After the proper draft has been determined for each pass, the electrical controls are set, and then continue to function automatically, making the required changes in roll setting for each pass. When the slab moves on to the finishing train the controls automatically restore the initial setting, ready to start the cycle again.

REVERSING STAND CONTROL

Automatic operation of the movements of vertical rolls and side guides, and of horizontal roll drafts, is secured from a single push-button station, which is pushed only once for each pass. The control equipment which carries out the cycle includes:—

1. One synchronous tie-motor mounted on the mill housing, geared to the screw-down drive.
2. One full magnetic reversing, plugging, dynamic braking duplex controller with armature shunt for operating the two 75 H.P. horizontal roll screwdown motors in parallel.
3. Two full magnetic, reversing, non-plugging, dynamic braking controllers with armature shunt for the two 25 H.P. vertical roll screwdown motors.
4. Three full magnetic, reversing, non-plugging, dynamic braking controllers with armature shunt for three 7½ H.P. side guide motors.
5. One synchronous tie-motor, differential cut-out, and panel assembly. This contains the plug-in panel which is designed to permit pre-selection of roll openings for two separate rolling schedules.
6. An operating desk, mounted in the front of the operator's pulpit.
7. Five waterproof cam-type limit switches, complete with magnetic declutching units for use on the vertical rolls and side guides. A magnetic clutch for coupling the horizontal roll screwdown motors and limit switches for final screwdown limit are also used.

This equipment provides full automatic operation of the seven motors driving horizontal and vertical screwdowns, and side guides, from the one pushbutton.

For semi-automatic operation, the horizontal rolls are set by the pushbutton, and the vertical screwdown and side guides are hand controlled. The entire operation may also be controlled manually.

To take care of the very wide range of slab widths, the limit switches used on the edger screwdown and side guides are provided with spring set clutches, which are arranged for magnetic release from the operators desk. They are of rotating cam type, and while making approximately 300 degrees rotation, allow a maximum travel of 4″, within which the edger screwdown and side guides are controlled. To accommodate wider slabs, the limit switches are disengaged from their drives, and permit the new settings to be made.

When the rolling schedule has been pre-set on the plug-in panel, and the vertical screwdown and side guides set for the correct width, the mill is ready for the slab. A pistol-grip switch is set to the position for the designated number of passes, and the desired multipole schedule relay is closed. If the indicating light shows that the differential cut-out is set for any pass other than No. 1, a "return-to-one" button brings it into starting position. The screwdown operating button is then pressed and the horizontal rolls move into position for the first pass, together with the vertical rolls and side guides. When the horizontal rolls move into this position, the differential cut-out immediately sets itself for pass No. 2, so that after the slab has passed through the rolls, only another push on the screwdown operating button is required to move the screwdowns and guides into position for pass No. 2. The cycle is repeated automatically until the number of passes for which the control was set have been made, when the differential cut-out returns to the No. 1 position.

Should a cobble, or other trouble, occur during rolling, hand control can be immediately restored by a master switch at the side of the operating desk.

The control is interlocked so that, when operating automatically, the synchronous tie-motors must be energized before the screwdown motors can be operated. Overload relays are connected so that an overload on any one motor will stop all motors. Push buttons on the operating desk also operate the high-pressure descaling sprays on the reversing mill.

Three sections of roller tables separate the reversing mill from the finishing train. The section immediately following the reversing mill is designed to operate at a speed of 400 ft. per minute, and the next two sections at 150–600 ft. per minute, the speeds being adjusted according to the size of slab and rate of cooling. Thus, temperatures of the slabs entering the finishing train may be governed according to metallurgical requirements.

FINISHING TRAIN

Immediately preceding the finishing train, a unique double pinch roll has been installed to act as a scale breaker. Two rolls operating under spring pressure give the slab a pinch to crack and loosen the secondary scale, which is then removed by hydraulic descaling jets.

From this point, the slab passes through the finishing train, which consists of four stands of 4-high 27″ and 54″ x 100″ mills. Each stand is driven through a gear

Finishing train of four stands, 4-high, each driven through a gear set by a 5000 horse power motor.

Control operators directing the movement of the plates through the four finishing stands.

set by a 5000 H.P., 600 volt, D.C. motor, the first three at speeds of 110-250 R.P.M., and the last at 125-265 R.P.M.

Delivery speeds of the finishing stands are as follows:

No. 1.....333– 760 ft. per min.
No. 2.....440–1000 " " "
No. 3.....530–1200 " " "
No. 4.....655–1386 " " "

The finishing train is equipped with specially designed motor-operated guides and loopers, and the entry and delivery guides are equipped with motor operated pull-backs to facilitate roll changing. The approach side of each of the last three finishing stands is equipped with a set of guards to safeguard the

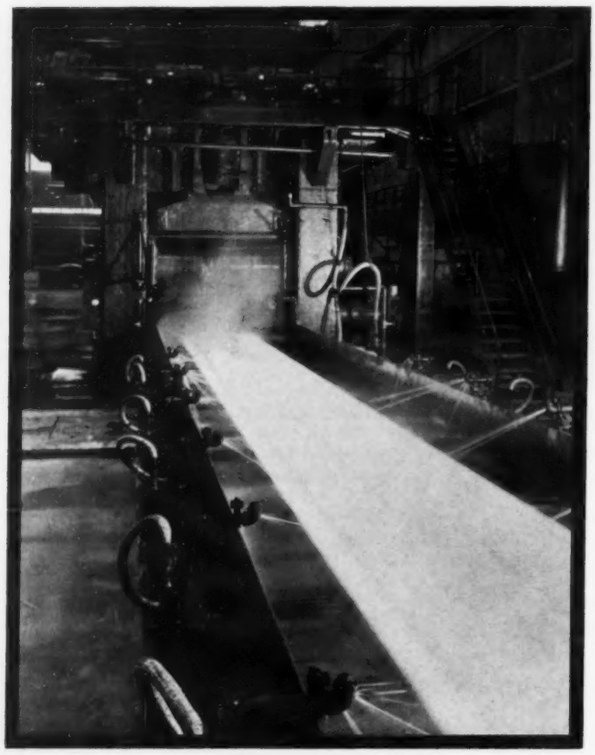


Plate leaving the last finishing stand, the first 60 feet of the run-out table being equipped with a series of cooling sprays.

mechanism from damage from heavy cobbles. Sections of tilting roller tables are used in this train instead of the customery chutes, so as to handle heavy plate without scratching. All surfaces coming into contact with the steel passing through the mill are finished so as to avoid the possibility of scratching.

It should be noted that the mill layout is such that ample space has been left between the roughing and finishing mills to permit the installation of an additional finishing scale breaker, if desired. This would make possible the rolling of wide strip on this mill.

The 4-high stands are equipped with tapered roller bearings, the reversing mill and the finishing stands having them on both back-up and work rolls, and the broadside mill having them on the work rolls. The scale breaker and the back-up rolls of the broadside mill are equipped with babbitted bearings of a new totally enclosed chock type. All back-up roller bearings are 33″ x 48″ x 31″, and have a rating of 1,133,280 lb. radial load and 217,000 lb. thrust load at 500 R.P.M. Work roll bearings on the reversing mill are 24″ x 31″ x 14¼″, and those on the finishing stands are 18″ x 23½″ x 11″.

Ground cup and cone spacers are used on these bearings, which are all 4-row assemblies, to give a pre-adjusted setting. The inner filler ring is shrunk on the roll neck and the chock has a special lip which fits close to the inner race of the bearing, making practically a sealed assembly when the bearing and chock are removed.

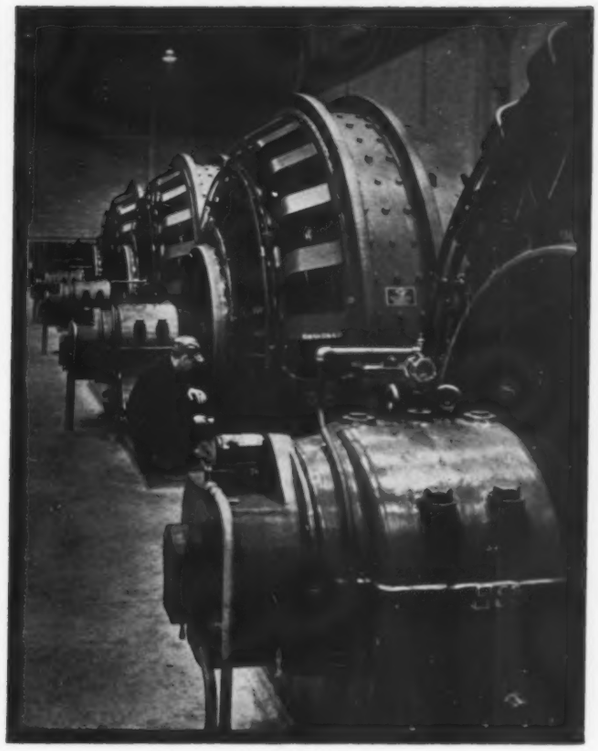
Screwdowns on all the mill stands are equipped with roller bearings, as are many drives, levellers, shears, tables, and other auxiliary units. Magnetic clutches between the motor shaft extensions on the screwdowns permit easy alignment of the rolls. Selsyn indicators are connected on each screwdown, readings showing in the operating pulpit for the roughing mills, and on the mill housings for the finishing train. Thus, roll settings are clearly indicated to the operator, and can be quickly and accurately adjusted.

Top back-up and work rolls are hydraulically balanced, the former by means of carrier bars and links suspended from cylinders mounted in the top housing separator, and the latter by hydraulic cylinders located in the bottom roll chocks. This system of roll balancing avoids the necessity of disconnecting any hydraulic connections when back-up roll changes are made.

Work roll changes are made with a porter bar, and the back-up roll changes with a specially designed motor operated rig. This unit fits in a covered pit adjoining each 4-high stand. A heavy fork is advanced under the roll assembly by means of a motor operated rack. The complete roll assembly, including the chocks, is lowered onto the fork by the hydraulic balance cylinders in the housing separators. The assembly is then withdrawn on the carriage. Each roll assembly with bearings and chocks can then be placed in the mill by reversing the above cycle. Roll changes are thus made in a minimum length of time.

To control rolling pressures and avoid undue strain on mill equipment, all 4-high stands are equipped with pressuremeters, using the stretch in the mill housing to actuate indicating and recording instruments located in the operating pulpits. One post in each housing is recessed to receive a gage bar made of the same material used in the housing. This bar is anchored firmly at one end, and the other end is connected to an inductance type strain gage, the whole assembly being surrounded by a light oil, and sealed to assure uniform temperature conditions between the housing and the gage bar. The units are calibrated by loading the housing by means of hydraulic jacks to a separating force of approximately 4,000,000 lb., the scales being marked to read directly in lb. of screw pressure. These gages are built into the mill housing, and therefore require no additional height and cause no difficulty during roll changing. The electrical circuits are provided with a zero point, so that errors due to gradual

Control room showing circuit breakers and other electrical equipment.



Close-up of main drive motors the largest of which being 7000 horsepower.

Motor room housing all main drive motors, gear drives, motor generator sets and switchboard equipment.

relief of strains in the housing, or to temperature differences, may be noticed and corrected. The general accuracy of this roll pressure measuring equipment, in proper condition, is to within ½%.

Four glass enclosed operating pulpits, elevated 12′ above the floor level, enable the mill operators to clearly observe the entire mill. The first pulpit, from which the scale breaker and first slab turning rig are controlled, is located on the drive side of the mill. The second pulpit, likewise located, controls the slab pusher, broadside mill, second turning rig, and the slab squeezer. The reversing mill is controlled from a third pulpit, on the operating side of the mill, immediately in front of the stand so as to afford a clear view of approach and delivery tables. The finishing train is controlled from the fourth pulpit, centrally located on the same side.

Leaving the last stand of the finishing train, the plate moves over a run-out table, the first 60 ft. of which is equipped with a series of cooling sprays. Rollers on this table are individually driven, and are made of centrifugally cast iron, ground to a smooth finish. All apron plates and skids on the transfer tables are likewise of cast iron with a ground finish. All roller tables, with the exception of the one serving the magazine slab feeder, are equipped with anti-friction bearings.

From the runout table, the plate is moved by a cable type transfer to a second cooling table, in which is located a specially designed roller leveller. This unit has two pinch rolls, 12″ x 108″, and seventeen levelling rolls, 8″ x 108″, and flattens product up to 5/16″thick. Each corner of the unit is individually adjustable, and the whole unit operates under a fully automatic screw-down mechanism. The leveller is oil cooled and oil lubricated. Following the leveller is another cooling table, divided into six sections, each driven by a shunt wound motor. The rolls are of disc or spool type, dynamically and statically balanced, with a ground finish. The discs are staggered to avoid uneven cooling.

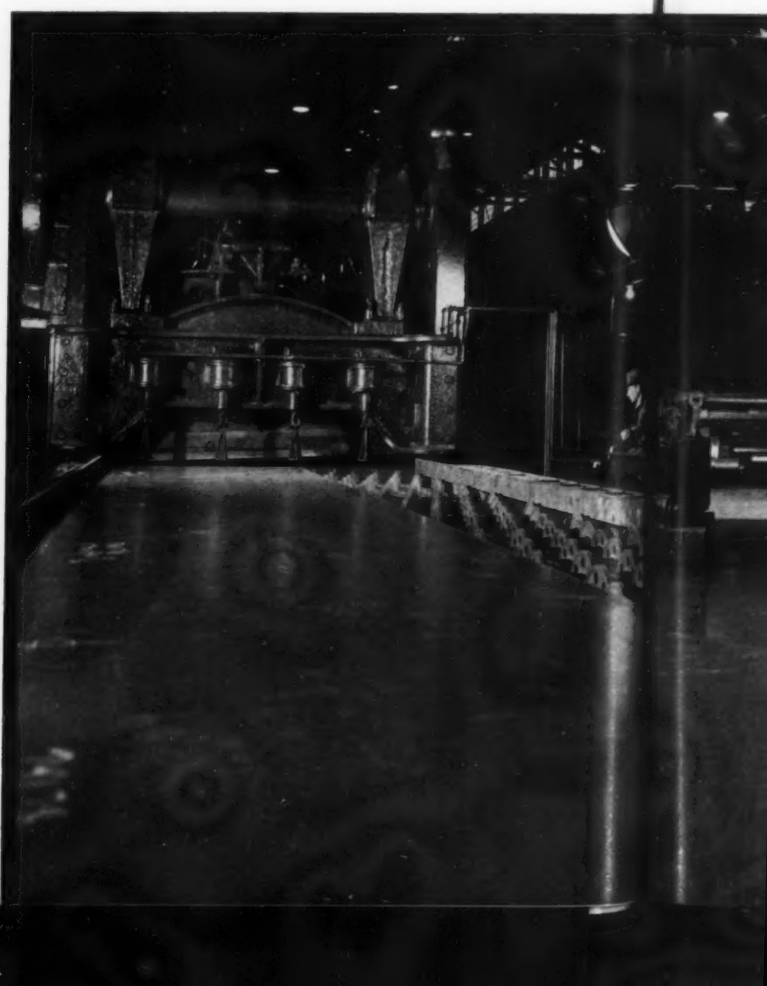
A second roller leveller, following this table is equipped with two pinch rolls, 12″ x 108″, and eleven levelling rolls of the same size, water cooled and grease lubricated. It flattens product 5/16″ thick and over, and delivers it to another table, from which a rack type transfer mechanism moves it across to another table. In this line is located the crop shear, which crops or divides the plate as required. Ordinarily, a 10″ crop will square up either end. After cropping, a chain type mechanism transfers the plate to a table serving a rotary shear which trims the edges. With accurate rolling, practically no camber exists in the plates, and 1″ to 1½″ sheared from the edges serves to true up the material. Electromagnets, operated from the control pulpit guide the plates through the shear. A stationary magnet lines up the plate on the conveyor table, while a second magnet, synchronized with the speed of the shear, travels with the plate through a portion of the shearing cycle. Proper entry and travel of the plate through the rotary shear is thus assured.

Following this, the plate may proceed through either of two rocking type shears. These shears were designed and built in the Homestead Plant, and eliminate the difficulty known as "shear bow," which was formerly encountered in plate shearing. Four heavy pneumatic fingers hold the plate in place while a specially heat treated curved blade rocks across with only point contact. This results in a clean, smooth, and even cut without strain, and leaves the surface scale smooth and tight, and the plate without any visible bow. Each shear is driven by a 150 H.P., D.C. Motor, through a gear reducer also built at Homestead to suit the special needs of this shear. Selsyn indicators at the operators pulpit enable them to control plate lengths to 1/32″ with a maximum length of 60 feet. All shears are equipped with continuous scrap cutters which feed directly into scrap buckets readily accessible to the cranes. Conveyors bring the crop ends to these cutters, except in the case of the rotary shear, where the side trimmings feed directly into scrap cutters operated in unison with the rotary shear.

From the rocking shear, plates advance to stacking beds, passing over recording scales which automatically print tickets for each plate, as well as integrate the successive weights. At the stacking beds, kickoffs are installed, consisting of lift arms located between the table rollers. The arms are equipped with small rollers whose axis are at right angles to the axis of the table rollers, so that the plates roll from the table to a pile without danger of scratching.

Space is available and plans are made for the addition of a normalizing furnace and another leveller, with the necessary tables. The normalizer will be of chain conveyor type, 9 feet inside width, with a 90 feet heating zone and a 40 feet cooling zone, completely insulated and steel jacketed. It will have a capacity of

Straight blade crop shear for cropping off the non-uniform ends of plate.



28,000 lb. of steel per hour, and will be fired with coke oven gas. Automatic temperature control will be provided.

Shipping facilities are provided by a depressed track, which runs the full length of the building and will accommodate about thirty cars, and by a roadway encircling the entire plant, with convenient truck loading docks in the shipping building.

A roll shop, adjacent to the mill building, contains a 60″ x 20′ roll lathe, a 60″ x 20′ roll grinder, and a degreasing machine for use in bearing maintenance. A transformer car of special design conveys roll assemblies to and from the shop.

Water for descaling purposes is provided by two multi-stage centrifugal pumps, rated at 900 G.P.M. at 1000 lb. pressure, each driven by an 800 H.P. motor. Water for hydraulic roll balance is supplied at 2500 lb. pressure by six single-acting vertical triplex pumps.

LUBRICATION

There are five oil systems installed, using 32,000 gallons of oil. One takes care of the pinions and screwdowns; another, the gear drive units, while the third furnished oil to the edger, and the fourth supplies the motors. The fifth is a purifying system for reclaiming used oil. An automatic grease system is also provided for those points requiring that type of lubrication. All oil and grease houses, pumps, filters, etc., are located in the basement. Two tunnels run the full length of the mill, one carrying oil lines and the other the high pressure and cooling water lines. Each piping system is painted a distinctive color and is fully identified. Where oil circulation is essential, duplicate pumps are installed, with automatic cut-in provisions in case one pump should fail. If both units should fail, a sufficient quantity of oil is always available in a reservoir to allow the mill to be cleared without damage to equipment.

CRANES

The following cranes service the mill:

Location	No.	Capacity Tons	Span
Magazine feeder building	1	10	29′–0″
Furnace building	2	10	78′–8″
Motor room	1	75	65′–3″
Mill building	1	100	88′–4″
Mill runout building	1	15	85′–6″
Shear building	2	20	40′–6″
Shipping building	4	20	85′–9″
Roll shop	1	100	73′–9″

Rotary shear for trimming edges. Electromagnets, operated from the control pulpit, guide the plates through the shear.

MOTOR ROOM

One motor room houses all main motors (described elsewhere in this article), gear drives, motor generator sets and switchboard equipment. The room is ventilated with filtered air under a slight pressure, furnished by four fans, each of 125,000 C. F. M. capacity. Two 65,000 C. F. M. units furnish air cooling for the drive motor of the reversing mill. Incoming power at 6600 volts comes to switch gear centrally located along the outside wall of the motor room, and is distributed to the equipment by cables running through conduit buried in the concrete floor. Three 1000 KVA, 6600/220 volt transformers furnish low voltage A.C. power. Another transformer bank, totaling 1000 KVA, furnished power for the river pump house, while a third bank of 1500 KVA capacity supplies plant lighting circuits.

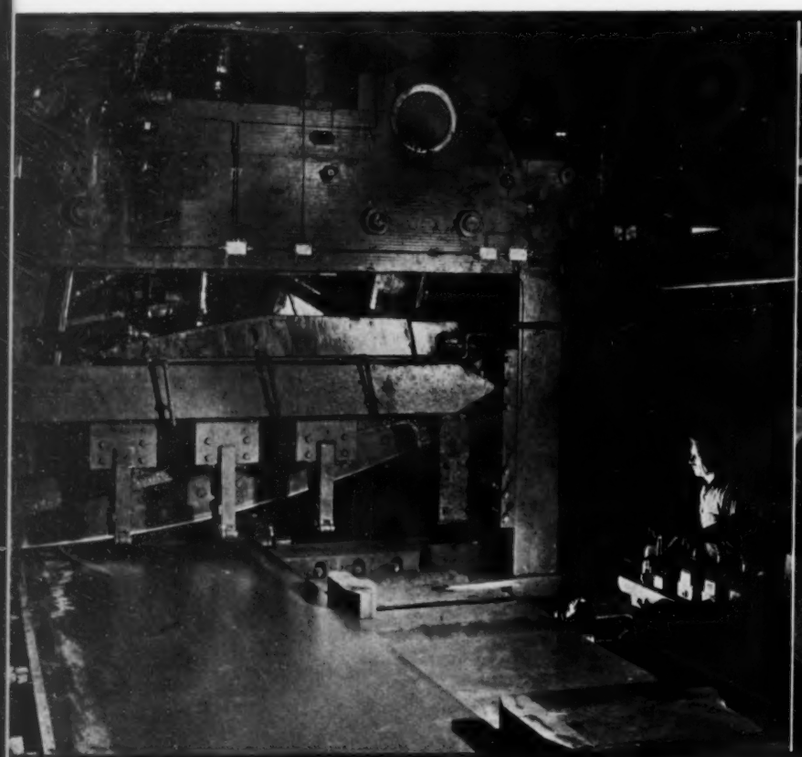
Power for the reversing rougher and edger is supplied by a dual motor-generator set, consisting of two 3000 KW, 700 volt DC generators driven by a 6000 H.P., 6600 volt, 25 cycle, 370 R.P.M. motor, with flywheel. Finishing stand motors are supplied with power from two dual-motor-generator sets, each consisting of two 3000 KW, 600 volt DC generators driven by an 8500 H.P., 6600 volt, 25 cycle, 375 R.P.M. motor. Auxiliary D.C. power is furnished by two motor-generator sets, each consisting of a 1500 KW, 250 volt D.C. generator and a 2100 H.P., 6600 volt, 25 cycle, 500 R.P.M. motor.

MILL DATA

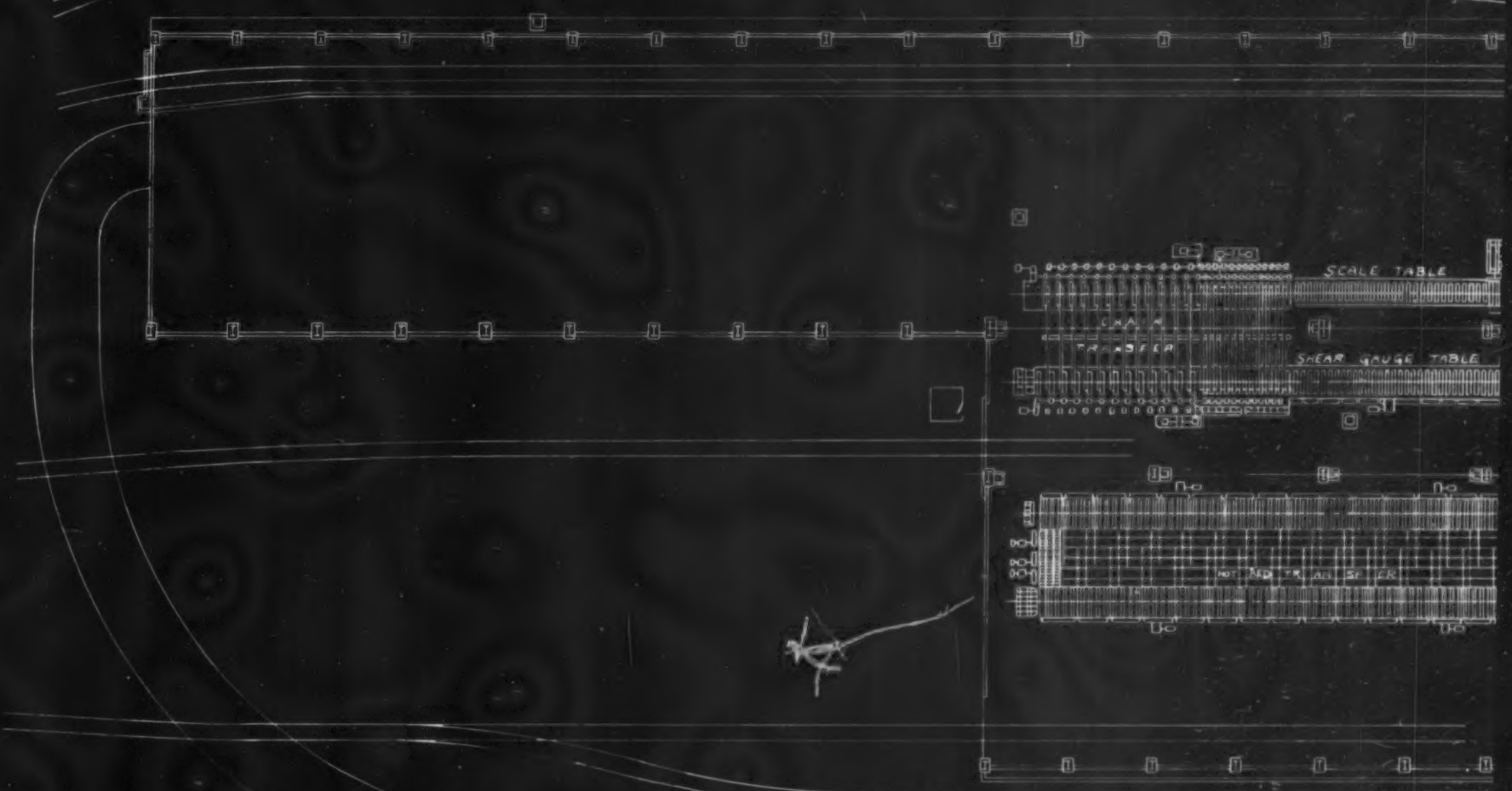
Stand	Characteristics	Diameter		Roll Length	Motor				Remarks
		Work rolls	Back-up roll		H.P.	Volts	R.P.M.	Type	
Scale breaker	1-stand, 2-high.	36″	.....	100″	1000	6600	500	A.C.	Geared. Flywheel.
Spreader	1-stand, 4-high.	42″	52″	120″	4500	6600	370	A.C.	Geared. Flywheel.
Vertical edger	1-stand.	40″	.....	10″	600	700	125–406	D.C.	Geared.
Reversing rougher	1-stand, 4-high.	36″	54″	100″	7000	700	40–80	D.C.	Direct.
No. 1 Finisher	1-stand, 4-high.	27″	54″	100″	5000	600	110–250	D.C.	Geared.
No. 2 Finisher	1-stand, 4-high.	27″	54″	100″	5000	600	110–250	D.C.	Geared.
No. 3 Finisher	1-stand, 4-high.	27″	54″	100″	5000	600	110–250	D.C.	Geared.
No. 4 Finisher	1-stand, 4-high.	27″	54″	100″	5000	600	125–265	D.C.	Geared.

Additional equipment in the motor room consists of an exciter M. G. set for the finishing train, rated at 400 KW, 250 volts D.C. and driven by a 600 H.P., 220 volt, 725 R.P.M. motor; a dynamic braking set for runout tables rated at 125 KW, 125 volts D.C., driven by a 125 H.P., 220 volt, 725 R.P.M. motor; an alternator set for runout tables, 167/406 KVA, 176/440 volts, 20/50 cycles, driven by a 250/300 H.P., 300 volt, 400/1000 R.P.M. motor; a 4-unit and a 5-unit exciter set for the reversing stand, rated respectively at 70 KW and 60/118 KW, and each driven by a 125 H.P., 220 volt, 730 R.P.M. motor.

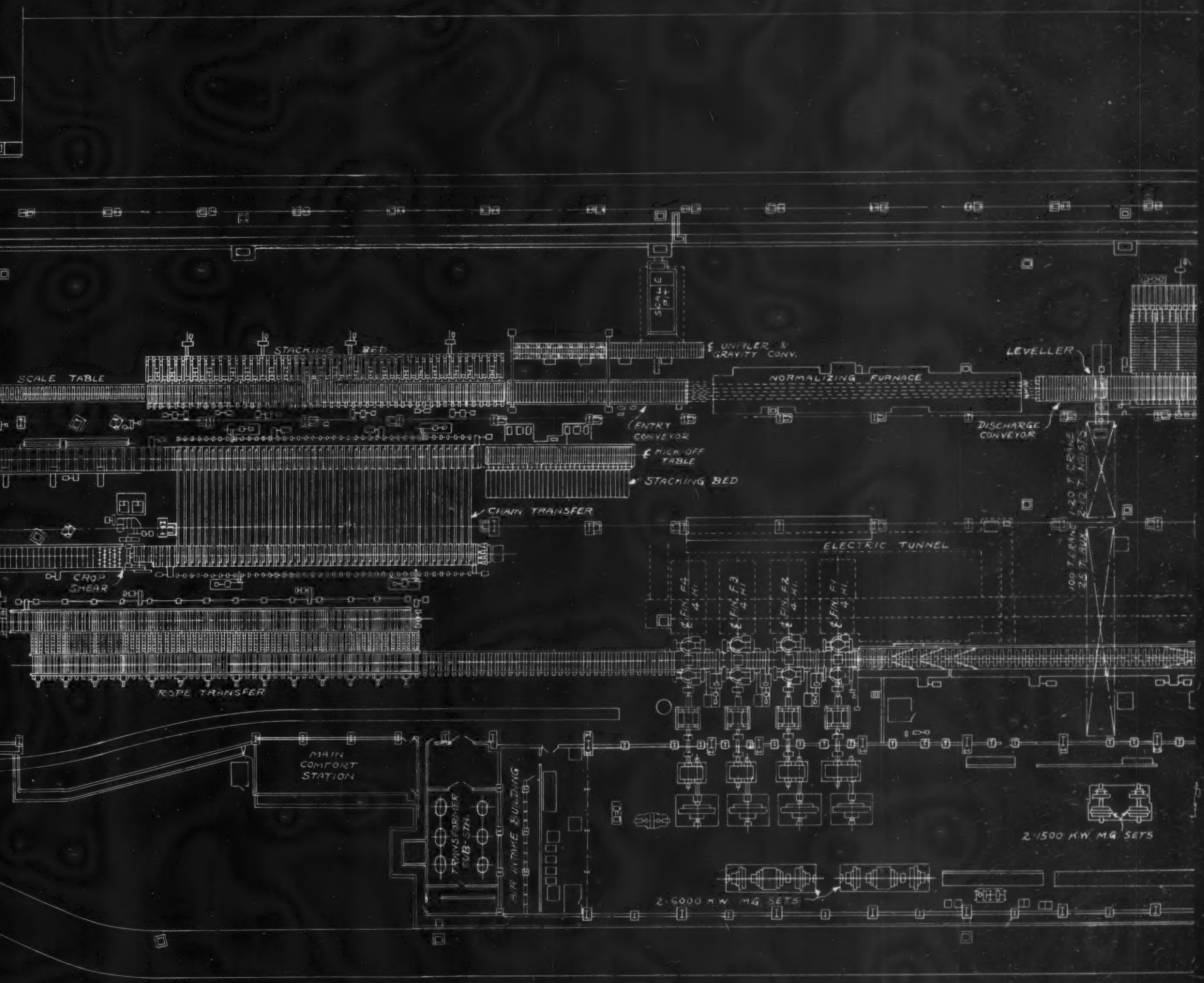
Specially designed rocking type shear eliminates the difficulty known as shear bow which was formerly encountered in plate shearing.



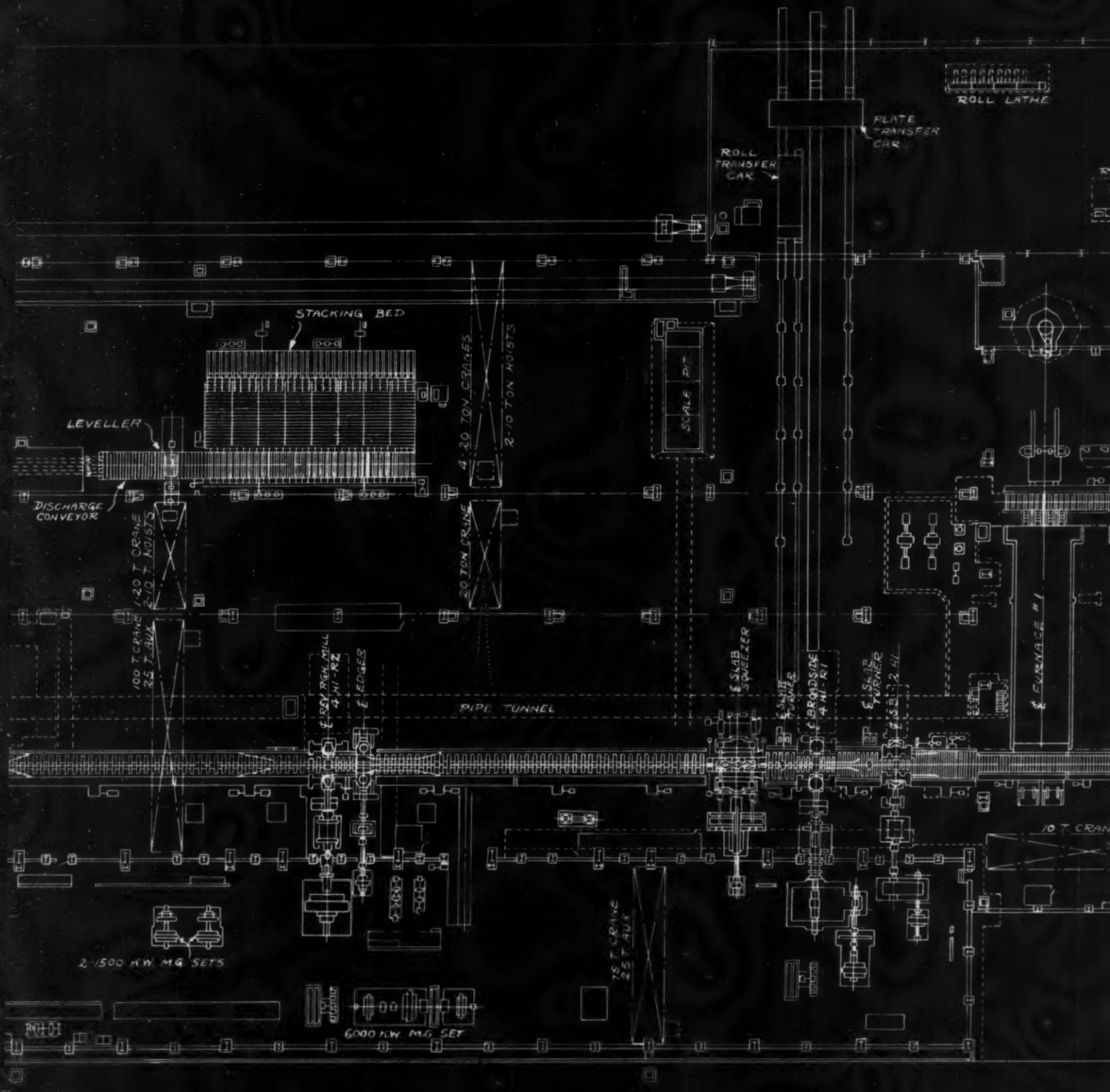
Kick-off or sorting stacker for separating the plates according to gauge, length, width, and individual orders of customers.


SCALE TABLE
SHEAR GAUGE TABLE

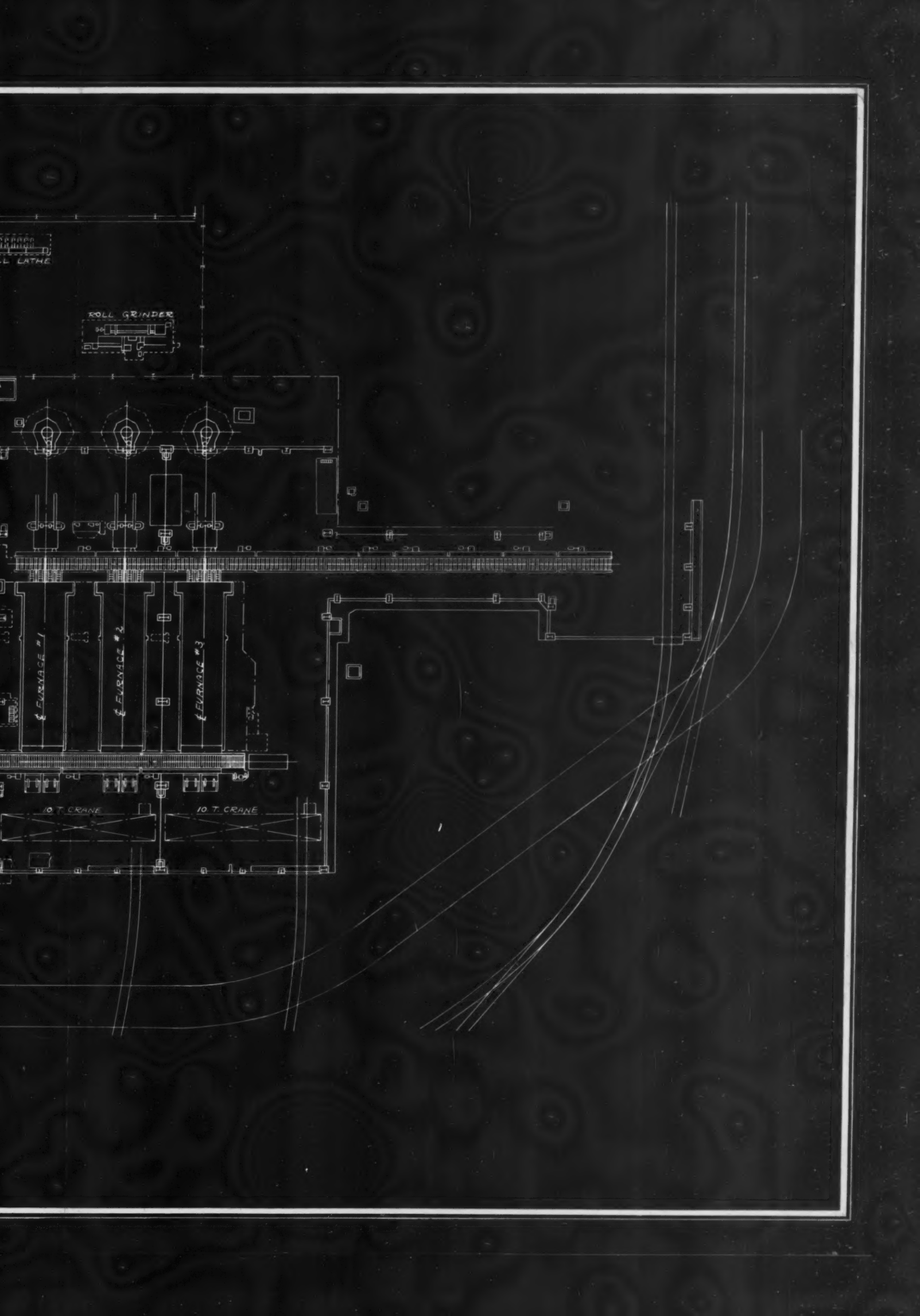
PLAN VIEW OF 100" SEMI-CONTINUOUS PLA



6 PLATE MILL, CARNEGIE-ILLINOIS STEEL CORPORAT



CORPORATION, HOMESTEAD, PA.


ROLL GRINDER
FURNACE #1
FURNACE #2
FURNACE #3
10 T. CRANE
10 T. CRANE

SUMMARY OF CONNECTED LOAD

Scale breaker motor	906 KVA
Broadside mill motor	3800 "
Motor generator sets	21620 "
Hydraulic pump motors	1460 "
Power transformers (6)	4000 "
Light transformers (3)	1500 "
Total	33286 KVA

A summary of the rotating electrical machinery in the entire mill shows:

	Number	Total
Motors	318	73534 H.P.
Generators	21	22164 H.P.

Power consumption of the main drives averages 44.8 K.W.H. per gross ton of steel rolled.

A list of main auxiliary drive power is appended.

MAIN AUXILIARY DRIVES

TABLES	No. of Motors	H.P.
Table "A"	4	200
Magazine Feeder Table	1	50
Table "B"	4	200
Table "C"	4	200
Table "D"	1	50
Table "E"	1	50
Slab Squeezer	1	50
Table "F"	1	50
Table "G"	2	100
Table "H"	2	150
Table "I"	2	150
Table "J"	3	300
Table "K"—Individual Drive	9	23
Table "L"	2	150
Tooling Table "M"	6	450
Cable "N"	2	150
Table "P"	2	100
Marking Table "R"	8	400
Table "S"	2	100
Table "T"	2	100
Table "U"	2	70
Table "V"	1	35
Table "W"	2	70
Table "AB"	2	70
Table "Y-1"	1	50
Table "AC"	1	50
Table "AD"	1	50
Table "AA-1"	1	85
Table "X"	2	70
Shear Gauge Table "Y"	1	50
Piler Table "AA"	2	100
Scale Table "Z"—Individual Drive	31	15½
Shear Table "Z-1"—Individual Drive	31	15½
Shear Depressing Tables—Ind. Drive	12	6

MAIN AUXILIARY DRIVES

Drive	No. of Motors	H.P.
Magazine Feeder Lift	1	100
Magazine Feeder Depiler	1	50
Squaring Stop at Scale Breaker	1	10
Furnace Air Compressor	1	50
Furnace Return Water Pump	1	125
Furnace Pushers	6	600
Furnace Charging Doors	5	25
Furnace Discharge Doors	5	25
Furnace Fans	3	150
Furnace Pumps	3	22½
Slab Lifts	2	50
Slab Turns	2	20
Table "D" Side Guard	1	7½
Scale Breaker Screwdown	1	50
Roll Balance Accumulators	3	22½
Slab Pushers	1	50
Broadside Screwdown	1	100
Slab Squeezer Adj. Head	1	50
Vertical Edger Feed Rolls	1	25
Table "H" Guide	1	7½
Vertical Screw Edger	1	50
Reversing Rougher Horizontal Screw	2	150
Reversing Rougher Auto. Screwdown	1	4¼
Table "I" Guide	1	7½
Table "J" Guide	1	7½
Screwdowns (4 Finishing Stands)	4	400
Finishing Stand Guides	3	30
Pull Backs	2	50
No. 1 Leveller Screwdown	1	10
No. 1 Leveller Main Drive	1	125/150
No. 1 Rope Transfer	1	100
No. 2 Leveller Main Drive	1	125/150
No. 2 Leveller Screwdown	1	25
No. 2 Plate Transfer	3	300
No. 1 Crop Shear	1	150
Scrap Shears	3	165
No. 3 Chain Transfer	2	150
Table "U" Hold Down Magnet Drive	4	20
Table "U" Magnet Traverse Drive	2	50
Rotary Shear (complete)	4	360
3—Scrap Conveyors	3	22½
No. 5 Chain Transfer	1	75
2—End Shears	2	300
No. 4 Rope Transfer	1	100
Piler Table "AA" Lifts	4	40
Piler Table "AA" Kickoffs	2	100
Table "AB" Side Guards	1	10
No. 2 Stacking Bed	3	30
Piler Table "AA-1" Kickoffs	1	75
Lubricating System "A"	3	126
Lubricating System "B"	3	126
Lubricating System "C"	3	22
Lubricating System "D"	3	17
Lubricating System "E"	2	9¾
Lubricating System "F"	3	30
Descaling Pumps (2)	2	1600
Normalizing Unit (complete)	12	512½

INSPECTION TRIP

New 100" Semi-Continuous Plate Mill

CARNEGIE-ILLINOIS STEEL CORPORATION

Homestead, Pa.

WEDNESDAY, JUNE 23, 1937 - 1:00 P. M.

Four High Finishing Train, (4 stands) Carnegie-Illinois Steel Corporation, New 100" Semi-continuous Plate Mill, Homestead, Pa.

Buses which the members and guests must use will leave the Grant Street entrance of the William Penn Hotel at 1:00 P. M. Tickets will go on sale in the Grant Street lobby of the William Penn Hotel at 10:30 A. M. the day of the trip. The price per person will be $1.50.

TECHNICAL SESSION - 8:00 P. M.

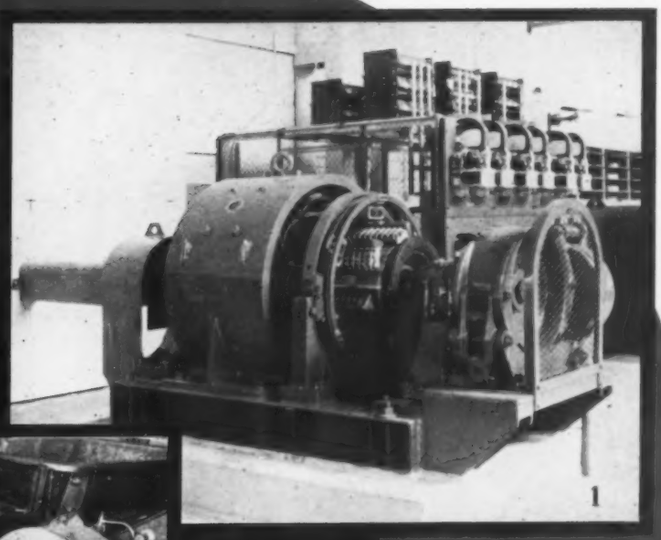
"FLOOD PROTECTION AND REHABILITATION"--SYMPOSIUM

This meeting will be preceeded by an informal dinner at 6:30 P. M.

CARDINAL ROOM - - - - - WILLIAM PENN HOTEL

ASSOCIATION OF IRON AND STEEL ENGINEERS

CROCKER-WHEELER MOTORS



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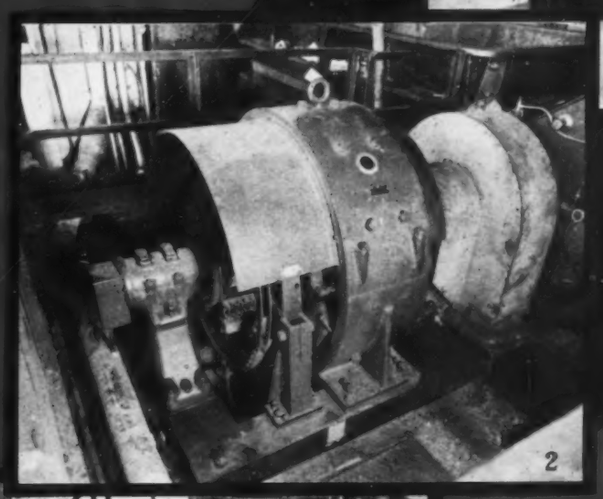

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3

AT HOMESTEAD

A number of Crocker-Wheeler motors were built for the new 100" semi-continuous plate mill of the Carnegie-Illinois Steel Corporation at Homestead, Pennsylvania. They are not the largest motors in the mill, by any means, but they have important jobs to do—jobs where poor performance or motor failure cannot be tolerated. The Illustrations show:

1. A 500 horsepower, 500 RPM motor coupled to slab squeezer.

2. 300 horsepower, 300/900 RPM motor driving rotary trimming shear.

3. One of two 125/150 horsepower, 400/1200 RPM motors furnished for leveller main drive.

CROCKER-WHEELER ELEC. MFG. CO.

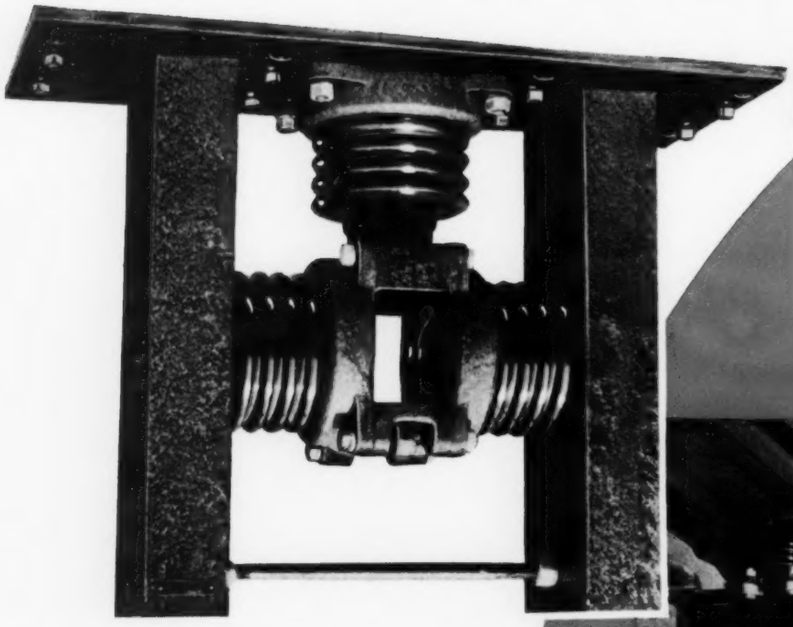
Main Office and Works: AMPERE, N. J.

SALES OFFICES IN PRINCIPAL CITIES

CROCKER-WHEELER

TRADE MARK REG. U.S. PAT. OFF.

EXCELLENT ENGINEERING



R&IE

IT'S ONE THING TO BE MODERN . .

The Wave of Modernism Sweeps On. New efficiency in the production line, new requirements of modern mill construction, new high capacities to supply the mammoth mill machinery — all demand better designs, more strength and absolute dependence of conductor supports.

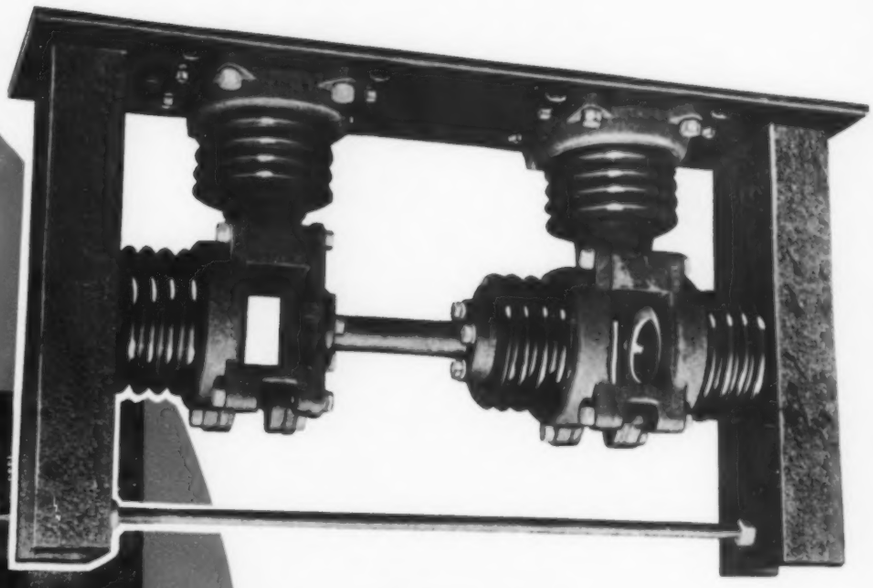
The conductor supports shown at top, left and right, and the spacer support shown at bottom left, were designed for six-inch heavy duty copper bus.

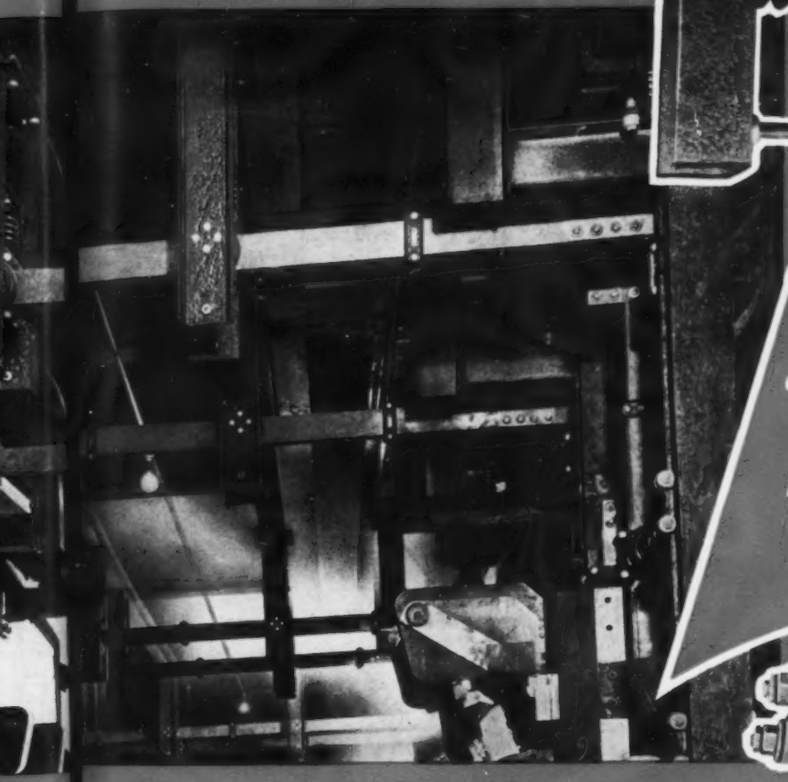
KIRK INTERLOCKS *and* **R&IE TESTERS**

RAILWAY AND INDUSTRIAL

OFFICE and FACTORY, GREENSBURG, PA.

CONDUCTOR SUPPORTS





..IT'S ANOTHER TO SET THE PACE

The Wave of Acceptance Sweeps On. R&IE, a pioneer in the industry, has set the pace of equipment advancement since introducing the original transmission apparatus. The many installations of R & I E high capacity conductor supports and switches are ample proof of their merit.

The conductor support shown at bottom right, was designed for corner mounting of a main double twelve-inch aluminum channel bus.

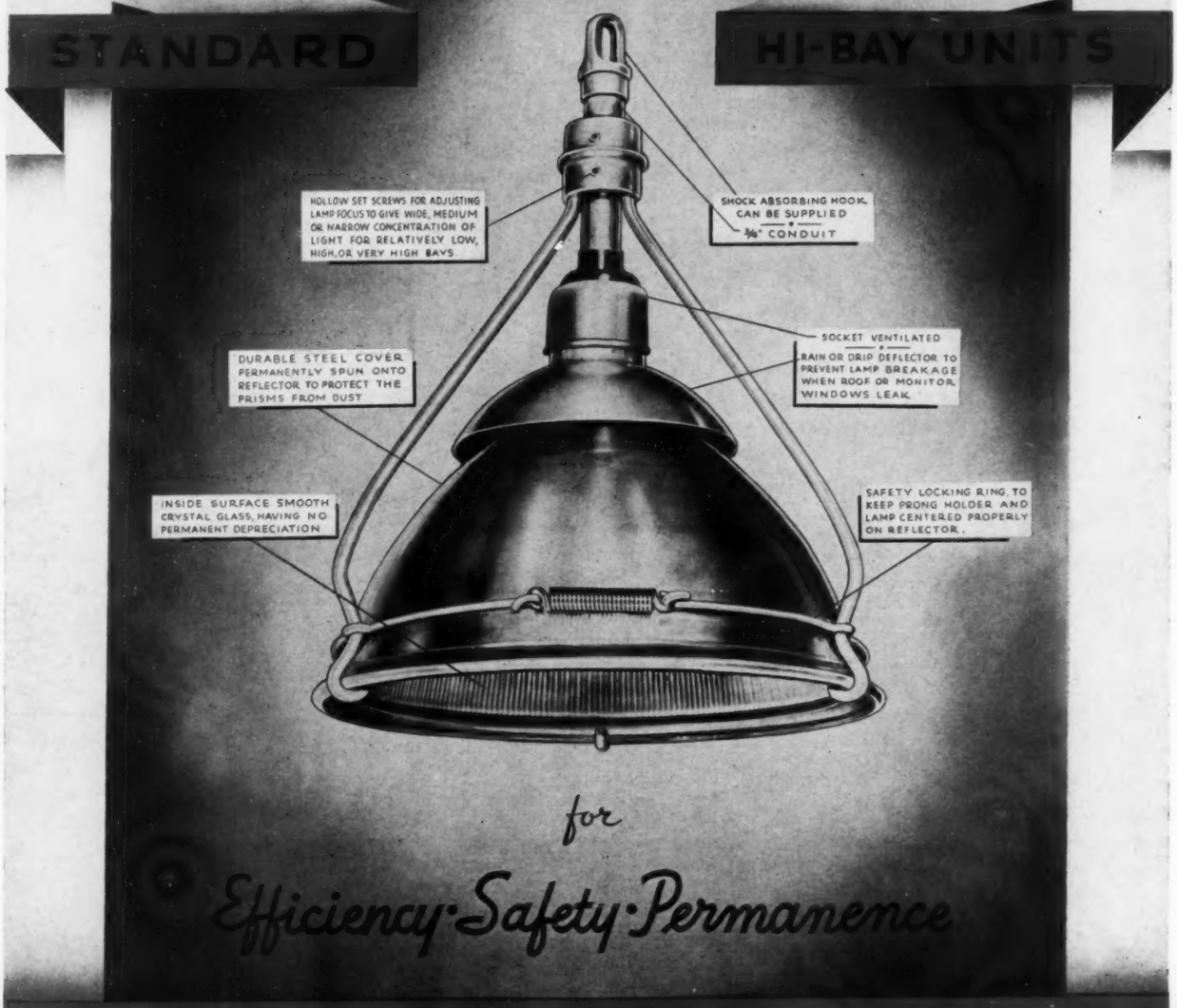
HI-PRESSURE CONTACT *switching equipment*

RI NGINEERING COMPANY

NSB LES OFFICES IN PRINCIPAL CITIES

HOLOPHANE

STANDARD HI-BAY UNITS


HOLLOW SET SCREWS FOR ADJUSTING LAMP FOCUS TO GIVE WIDE, MEDIUM OR NARROW CONCENTRATION OF LIGHT FOR RELATIVELY LOW, HIGH, OR VERY HIGH BAYS.
SHOCK ABSORBING HOOK. CAN BE SUPPLIED
¾" CONDUIT
SOCKET VENTILATED
RAIN OR DRIP DEFLECTOR TO PREVENT LAMP BREAKAGE WHEN ROOF OR MONITOR WINDOWS LEAK.
DURABLE STEEL COVER PERMANENTLY SPUN ONTO REFLECTOR TO PROTECT THE PRISMS FROM DUST
INSIDE SURFACE SMOOTH CRYSTAL GLASS, HAVING NO PERMANENT DEPRECIATION
SAFETY LOCKING RING, TO KEEP PRONG HOLDER AND LAMP CENTERED PROPERLY ON REFLECTOR.

for

Efficiency · Safety · Permanence

ANOTHER NEW STRIP MILL USES HOLOPHANE

ILLUSTRATED: No. 690 ST FOR 1000 WATT MAZDA LAMPS

● WRITE FOR ENGINEERING DATA ON HOLOPHANE HI-BAY SPECIFICS ●

HOLOPHANE COMPANY, INC.

342 MADISON AVENUE NEW YORK, N. Y.

TIMKEN bearings

ARE USED ON ROUGHING AND FINISHING STAND ROLLS IN THE NEW CARNEGIE-ILLINOIS 100" PLATE MILL

Back-up and work rolls of the 4-high reversing roughing stand and the 4, 4-high continuous finishing stands of the new "United" 100" semi-continuous sheared plate mill at the Homestead plant of the Carnegie-Illinois Steel Corporation are equipped with TIMKEN Roll Neck Bearings, a total of 40 being required.

The back-up roll bearings measure 31" x 48" x 33", while the work roll bearings in the roughing mill are 24" x 31" x 14¼" and those in the finishing train 18" x 23½" x 11". In addition to the roll necks, the screwdowns on all stands are TIMKEN-equipped, as also are many accessory units including drives, levelers, shears, approach, runout and transfer tables.

Outstanding characteristics of plate produced by this mill are uniformity of gauge, accuracy of size, fine surface finish and freedom from shear bow. TIMKEN Roll Neck Bearings are important factors in securing these desirable results.

THE TIMKEN ROLLER BEARING COMPANY, CANTON, OHIO

Manufacturers of Timken Tapered Roller Bearings for automobiles, motor trucks, railroad cars and locomotives and all kinds of industrial machinery; Timken Alloy Steels and Carbon and Alloy Seamless Tubing; and Timken Rock Bits.

TIMKEN *TAPERED ROLLER* BEARINGS

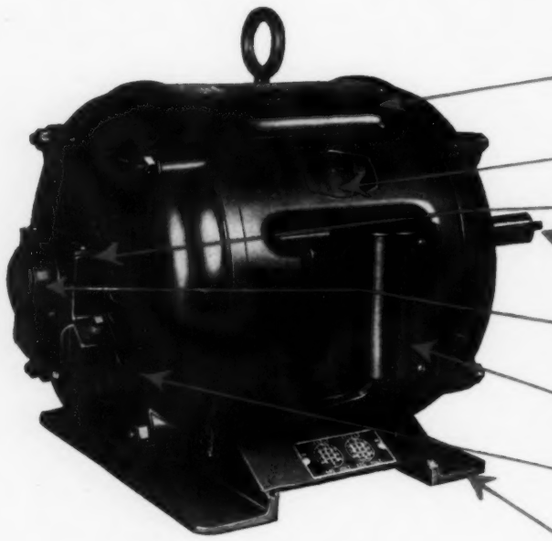
WAGNER has furnished motors for the steel industry for many years and has continuously improved motors for this purpose. Among the outstanding features of Wagner motors are: (1) QUIET OPERATION, (2) special operating characteristics to meet this exacting service, (3) long life, and (4) attractive appearance. As a result of Wagner's many years of experience in building motors for the steel industry, Wagner motors are leaders in this field.

YOU WILL BE BETTER SATISFIED

WHEN YOU INSTALL

Wagner POLYPHASE MOTORS

THEY MEET YOUR REQUIREMENTS OF PERFORMANCE AND DEPENDABILITY



A FEW OF THE POINTS OF SUPERIORITY OF WAGNER SQUIRREL-CAGE MOTORS ARE:

FRAME is fabricated from heavy steel-plate rolled into cylindrical shape and welded.

AIR-OUTLETS are extra large for unrestricted ventilation.

OIL-WELL HOUSINGS are sealed against the entrance of dirt and grit, and the escape of oil.

SHAFT is designed to carry mechanical overloads.

BEARING is steel-backed, babbitt-lined. Wagner also furnishes ball or roller bearings.

CONDUIT-BOX is mountable in four positions.

END-PLATES are liberally designed, heavy and massive, amply strong and rigid, to withstand severe service conditions.

FEET are of steel, welded to the stator-frame—accurately spaced according to Wagner dimensional diagram sheets.

Many other features of Wagner motors are worth investigating. Write today for Bulletin 182

The Wagner line includes all types of motors generally applied in the steel industry, making it possible for you to completely equip your plant with Wagner motors. Whether alternating or direct current; single or polyphase; open, drip-proof, or totally-enclosed; rigid or resilient-mounted—there's a Wagner motor now in existence, ready to be applied on the job.

ML 337-3F

Wagner Electric Corporation
6400 Plymouth Avenue, Saint Louis, U.S.A.
MOTORS · TRANSFORMERS · FANS · BRAKES

Perfection in finished Steel

a single Push Button Controls Rolls to PRESET Drafts on 100 inch Homestead Plate Mill

It's a Fast Method...and it's accurate

• Finished Steel of high quality—hard, smooth, blue-surfaced plates—reduced during rolling operations under finger-tip control. Proper roll drafts, that permit fast operation and maintain quality, are preset. The button is pressed and the desired reduction per pass is secured *automatically.*

• ***Total rolling time is short.*** Only 90 seconds are required from the time that the slab comes out of the furnace until it leaves the last finishing stand in finished plate form. ***It's accurate, too.*** One piece, checked after the last automatic pass through the roughing mill, measured within two thousandths of an inch of the setting on the draft-selector panel.

• The EC&M Automatic PRESET Screwdown Control, applicable to Blooming, Slabbing and Plate Mills, permits as many rolling schedules and passes as desired. ***There's no time lost in changing schedules.*** Press a button—one schedule is disconnected and another connected in—and the mill is ready for rolling the new piece. Investigate this advanced and modern system of screwdown control to-day. Full details upon request.

The Automatic System requires only 5 additional leads to the mill stand; remaining automatic equipment mounted in control room or operator's pulpit.

At right is shown entry side of the reversing, roughing mill and the operator's pulpit. Adjustment of the vertical rolls and front and back side guides are also secured automatically from the single push button which controls the horizontal roll movements.

THE ELECTRIC CONTROLLER & MFG. CO. E&M CLEVELAND, OHIO

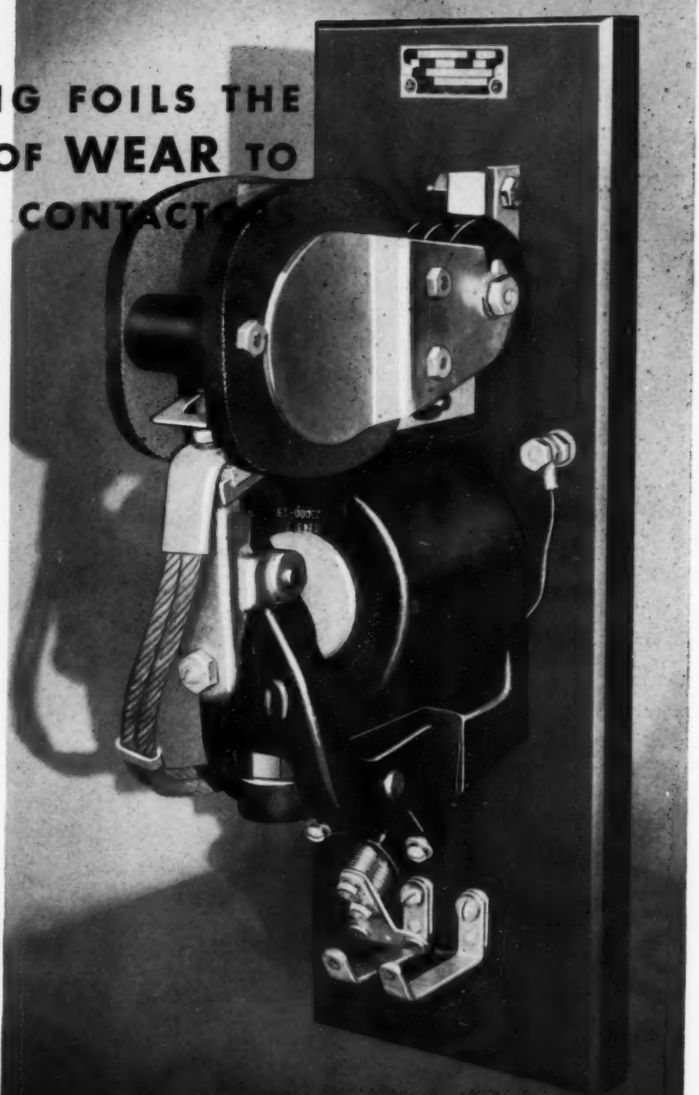
EC&M Automatic PRE-SET Screwdown Control

THE CHISELER *Chiseled!*

CLARK ENGINEERING FOILS THE PERSISTENT EFFORTS OF WEAR TO SHORTEN THE LIFE OF CONTACTORS

WEAR, little demon that he is, finds himself thwarted in every attempt he makes to destroy the Clark Contactor. He discovers to his chagrin that:

1. The arc shield is made of Carborax, practically impervious to arcing and heat.
2. The blow-out coil has more turns and a larger cross section. Result: greater magnetic effect and increased carrying capacity.
3. The blow-out coil is fastened securely to the terminal studs by Everdur bolts, which have approximately the same coefficient of expansion as copper.
4. The movable contact arm and main arm turn on renewable Nitralloy pins surrounded by renewable Nitralloy bushings—"Nitralloy to Nitralloy"—minimizing wear. Easily adjusted to maintain correct contact pressure.



The Clark 300-ampere, single-pole contactor. Observe how in this trim, business-like Clark unit cotter pins have been eliminated in both Movable Contact Arm and Main Arm. At all pivotal points—wherever there is relative motion—renewable Nitralloy pins and renewable Nitralloy bushings have been installed. The same features are found in the 100-, 150-, and 600-ampere contactors.

THE CLARK CONTROLLER COMPANY

1146 EAST 152nd STREET CLEVELAND, OHIO

Schloemann Installations in a plate mill at Pittsburgh

Left—"Motor-Roller" equipped Scale Tables

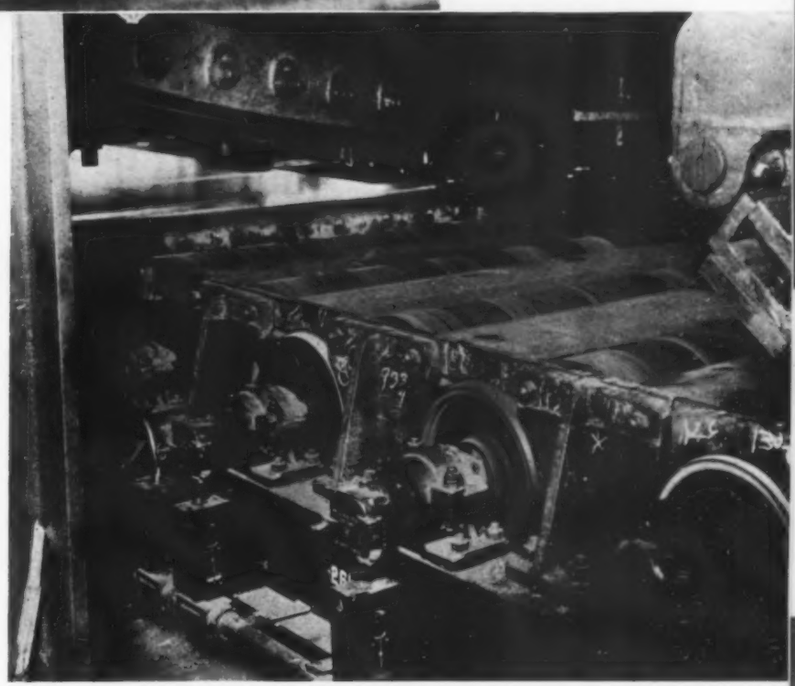
Below—
"Motor-Roller" equipped Shear Depressing Tables at Rocking Shears

EXCLUSIVE ADVANTAGES *of* SCHLOEMANN "MOTOR-ROLLERS"

With the rotating trunnion-type roller housing the driving motor, the necessity for using line shafts, couplings and gear reduction units is eliminated. Simplified table construction is the result, affording free access along both sides of "Motor-Roller" Tables.

Installation of rollers between the housings of Mill Stands and Shear Housings is possible without introducing complicated or weak elements.

Fewer wearing parts provide the ruggedness and dependability essential in mill service with reduced operating and maintenance costs.



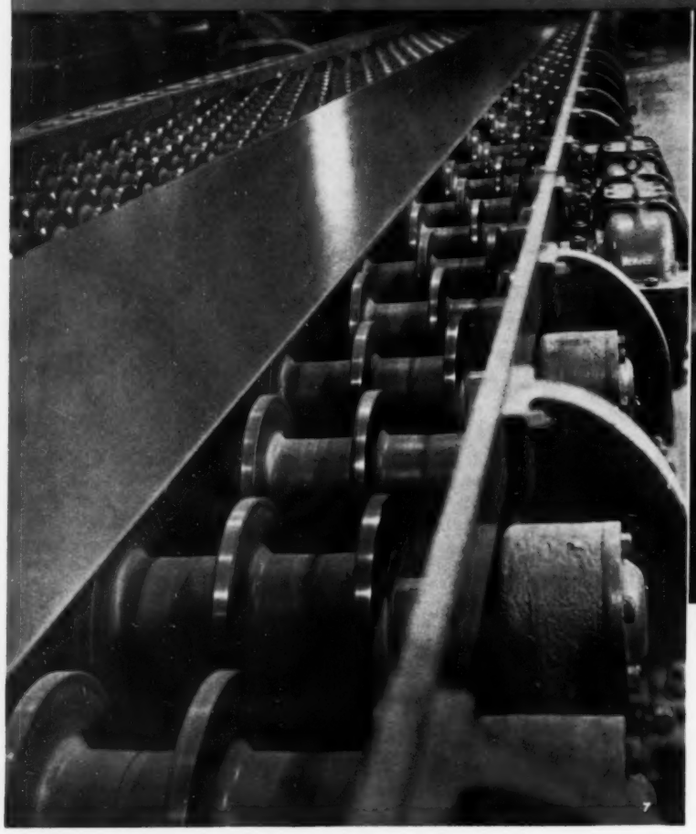
Each "Motor-Roller" installation is designed and built for the particular requirements of its application.

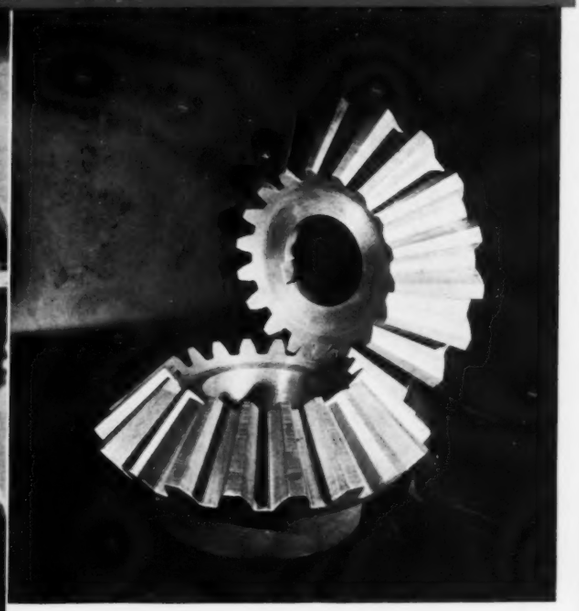
SCHLOEMANN

ENGINEERING CO. PITTSBURGH, PA.

Rolling Mill Machinery Hydraulic Presses

1420 NATIONAL-ERIE HARDENING STEEL TABLE MITER GEARS FURNISHED FOR THIS PLATE MILL





TO secure maximum service the engineers designing this plate mill specified heated treated and hardened steel gears.

In addition to the Table Miter Gears, National-Erie furnished 134 Spur and Sykes Herringbone Gear drives. All Sykes Herringbone Gears that were furnished complete are **NELOY No. 3** Steel 220-240 Brinell. Whether your next order is for 1 gear or a complete Mill Drive, it will pay you to specify National-Erie.

MANY USERS HAVE ADOPTED

"NELOY GEARS"

AS STANDARD EQUIPMENT

NATIONAL-ERIE CORPORATION

ERIE, PENNA.

HUNT (Quick-As-Wink)

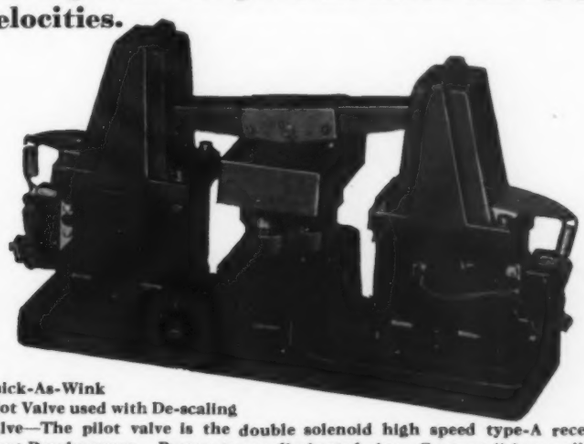
MODERN HYDRAULIC DE-SCALING VALVES INSTALLED IN A HOMESTEAD, PA. PLATE MILL

(all the operating valves in this installation are Hunt Valves)

ONLY one moving part—No metal-to-metal wear. Absolute regulation of operating speeds—Opening Speed or Closing Speed independently controlled at will—

POSITIVELY ELIMINATES WATER HAMMER

All water passages completely machined—Extremely Low Pressure Drop—Velocities through valve 20 per cent lower than pipe velocities.



Quick-As-Wink Pilot Valve used with De-scaling Valve—The pilot valve is the double solenoid high speed type-A recent Hunt Development. Burnouts are eliminated since Current "time-on" is the lowest that is possible—current being "on" but an instant for valve action or reversal—The Q.A.W. air control valve units are guaranteed against leakage—no metal-to-metal wear—give millions of operations without repair or leakage. Numerous combinations available for any air control job. Ask for Catalog "IS".

INSTALLATIONS

McDONALD
LACKAWANNA
NEWPORT, KY.
GRANITE CITY, ILL.
DETROIT
ECORSE
GARY
BUTLER
MIDDLETOWN
PITTSBURGH
HOMESTEAD
MUNHALL
ALIQUIPPA
CHICAGO
4 INSTALLATIONS
WEIRTON

BEING INSTALLED

REPUBLIC—CLEVELAND
C. & I.—BIRMINGHAM

High Accessibility, Inspection and Re-Assembly in a few minutes—

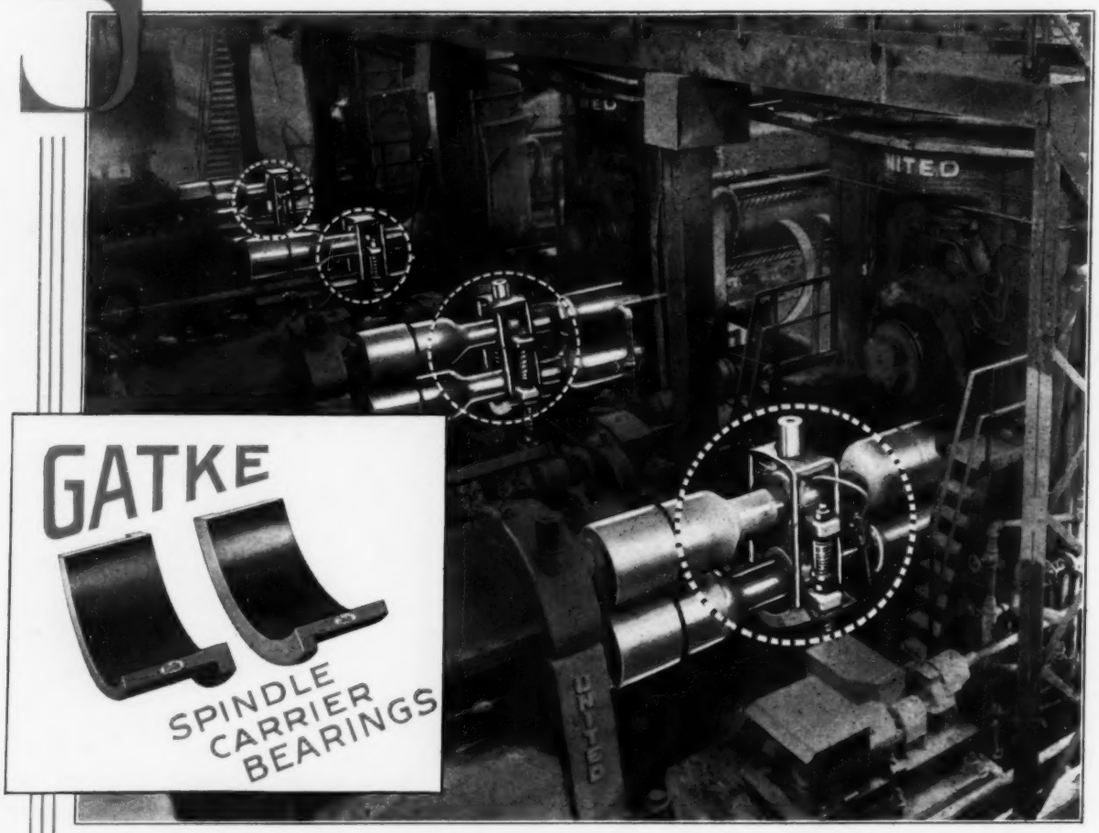
Details on Request.

OTHER OUTSTANDING Q.A.W. PRODUCTS

Air Control Valves—Guaranteed Leak-Proof. Hydraulic Valves—No metal-to-metal wear. Valve Couplings—Fool proof—Leak proof, Instant Operating. Hose Couplings, Roll Coolers.

C.B. HUNT & SON – SALEM, OHIO

SPINDLE CARRIER BEARINGS



Modern Bearings for Modern Mills

Moulded Non-metallic

TOUGH, resilient, non-metallic bearings, long lived because of their tremendous wear-resistance — Water lubrication results in a clean mill — Friction coefficient is the lowest of any known substance usable for bearings — Because their shock resistance is 10 times that of metal, they minimize spindle vibration — An inherent quality of Gatke Bearings is that they can not score.

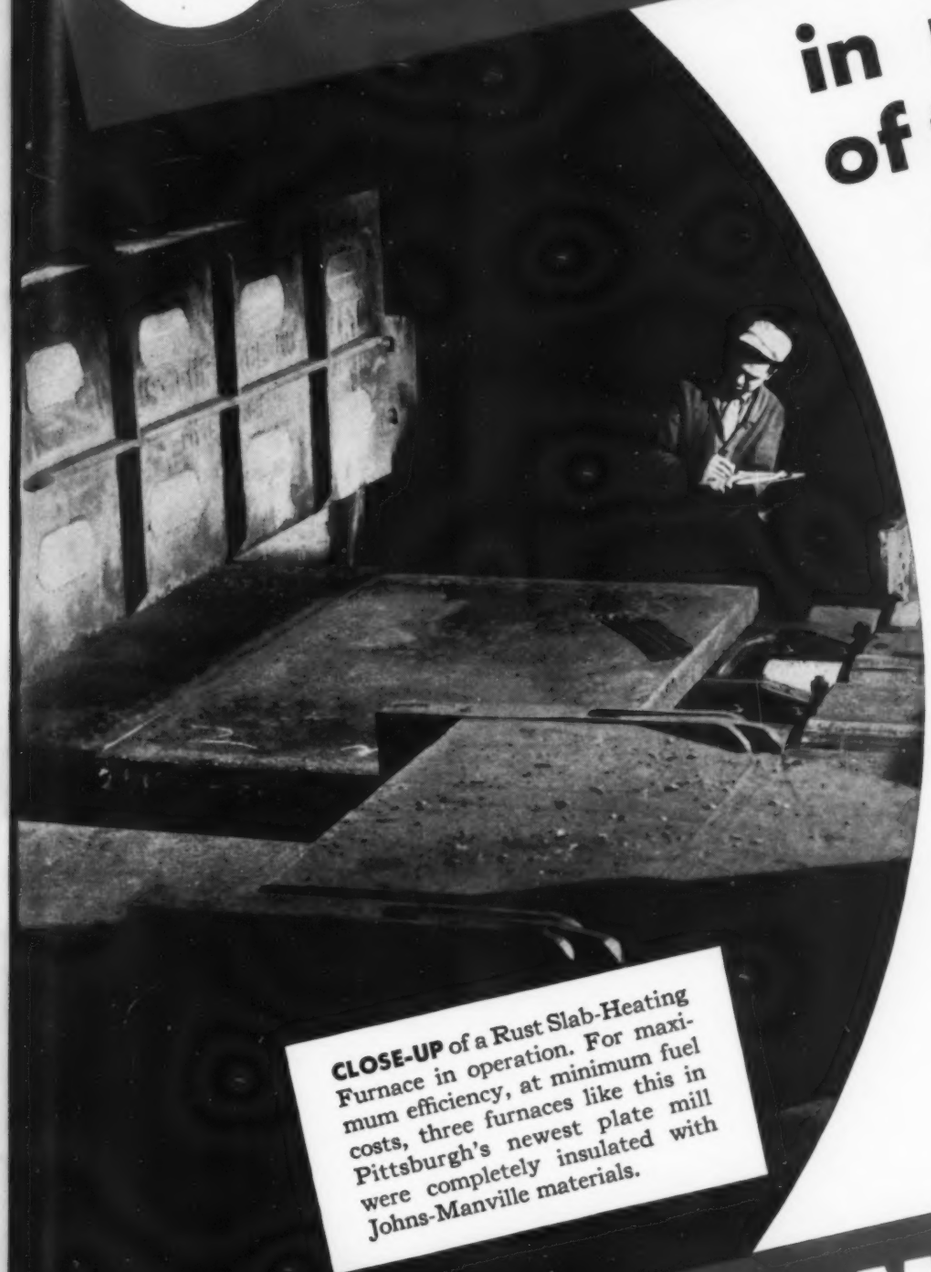
GATKE CORPORATION
228 NORTH LA SALLE STREET
CHICAGO • ILLINOIS

GATKE BEARINGS *are Hellers for Wear!*

Gatke pioneered molded non-metallic bearings. They are manufactured in many varieties of stock and special shapes and dimensions, and in an acid-resistant grade, not alone for many steel mill applications but for paper mills, chemical plants, oil wells, other widely diversified industries. They have made amazing records. © 1937

Once Again...

in recognition of their lasting efficiency!



CLOSE-UP of a Rust Slab-Heating Furnace in operation. For maximum efficiency, at minimum fuel costs, three furnaces like this in Pittsburgh's newest plate mill were completely insulated with Johns-Manville materials.

STEEL PROGRESS marches forward . . . as the newest and most modern of plate mills is erected in Pittsburgh, Pa.

And with the operation of three new Rust Slab-Heating Furnaces in this mill, there begins another record of superior insulating performance. Specified for insulating these furnaces were Johns-Manville's well-known Superex Blocks, Sil-O-Cel C-22 Brick, Sil-O-Cel C-3 Concrete and J-M No. 500 Insulating Cement.

Here, as throughout the steel mills of America, these Johns-Manville Insulations provide a dependable safeguard against wasted heat . . . and thus, keep operating costs permanently low. Johns-Manville, 22 East 40th Street, New York City.

JM

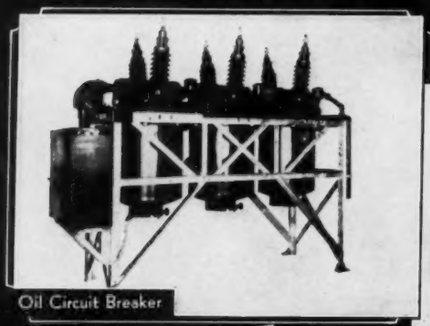
Johns-Manville
INDUSTRIAL INSULATIONS

An insulating material for every temperature ... for every service condition

DELTA-STAR ELECTRIC CO.

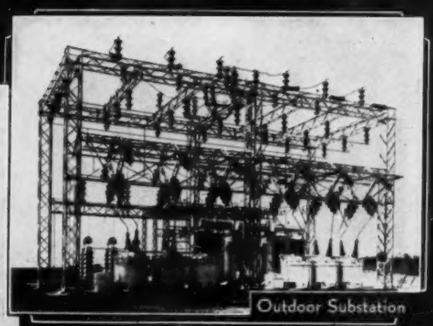
2400 Block, Fulton St. Chicago, Illinois

HIGH TENSION EQUIPMENT

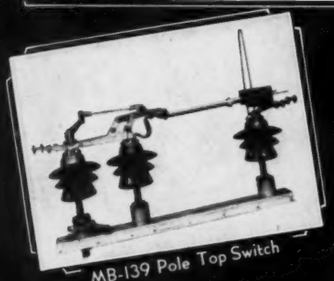


Oil Circuit Breaker

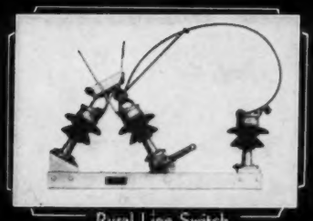
Steel Mill Cubicle



Outdoor Substation



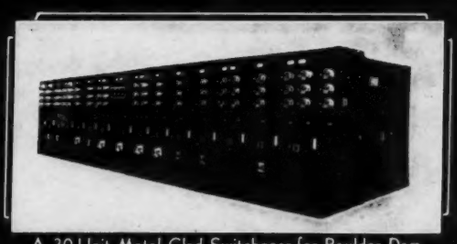
MB-139 Pole Top Switch



Rural Line Switch

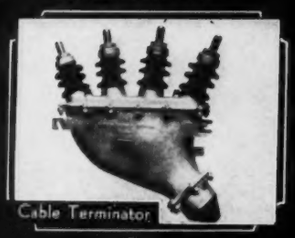
PM-23 Pole Top Switch

Outdoor Disconnect

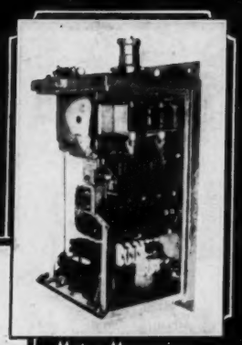


A 30 Unit Metal-Clad Switchgear for Boulder Dam

Indoor Bus Support

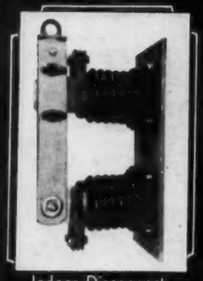


Cable Terminator



Motor Mechanism

Solderless Connector



Indoor Disconnect

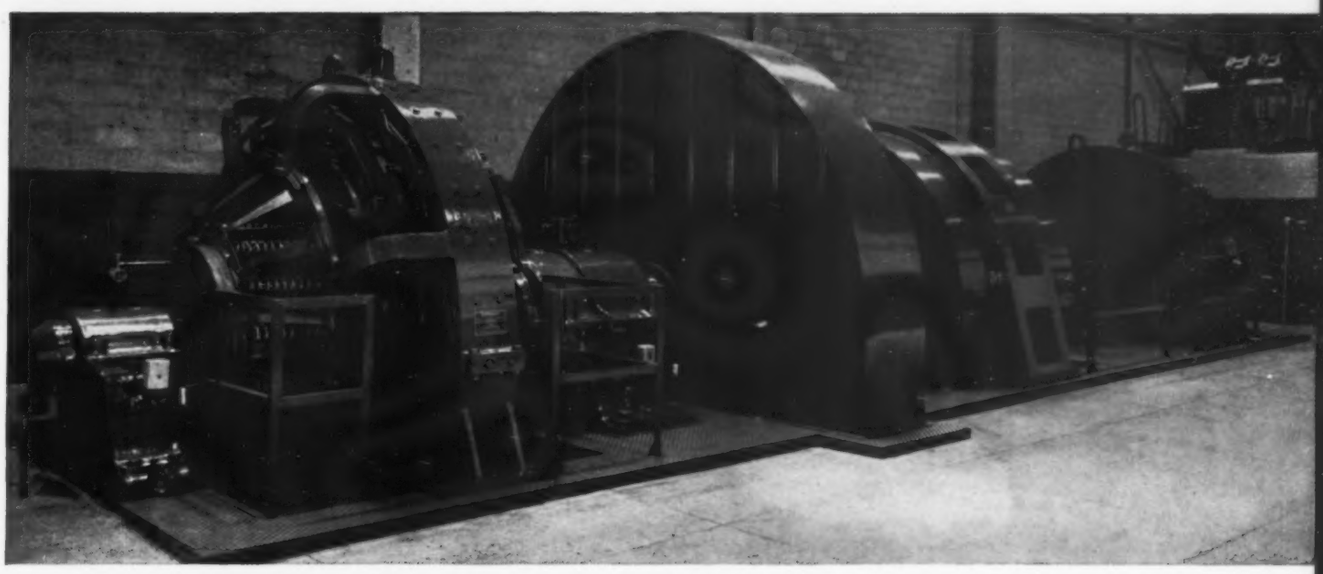
Flexible Terminal

UNIT TYPE EQUIPMENT

BULLETINS Sent on Request

DELTA-STAR Products

Air Break Switches
Boxes—Underground Cable
Bus Supports—Indoor, Outdoor
Bus Fittings—All Types
Bushings—Entrance Tube
Cable Supports—Up to 600 Volts
Circuit Breakers—Oil Blast
Clamps—Bus-Bar and Ground
Connectors—Clamp or Solder Type
Control Switches
Crane Rail Supports
Cubicle Switchgear
Designator Signs
Disconnecting Switches
Distribution Centers
End Bells—Cable, Conduit
Expansion Joints
Fabricating—Steel Substations
Farm Lighting Equipment
Fixtures—Street Lighting
Fuse Mountings—Indoor, Outdoor
Fuses—Up to 132 Kv.
Grounding Switches
Group Operated Switches
Insulators, Indoor, Outdoor
Lugs—Clamp or Solder Type
Metal-Clad Switchgear
Motor Mechanisms
Plugs and Receptacles—600 Volt
Rural Line Switches
Substations—Indoor, Outdoor
Terminators—Indoor, Outdoor
"Uniclamp" Pipe Fittings
Vault Units
Wall Entrance Bushings



MILL DRIVE EQUIPMENT

for New Plate Mill in Pittsburgh District

"SA"

SERIES BRUSHES

will give outstanding performance on YOUR equipment, as they do on mill drive equipment in this new plate mill.

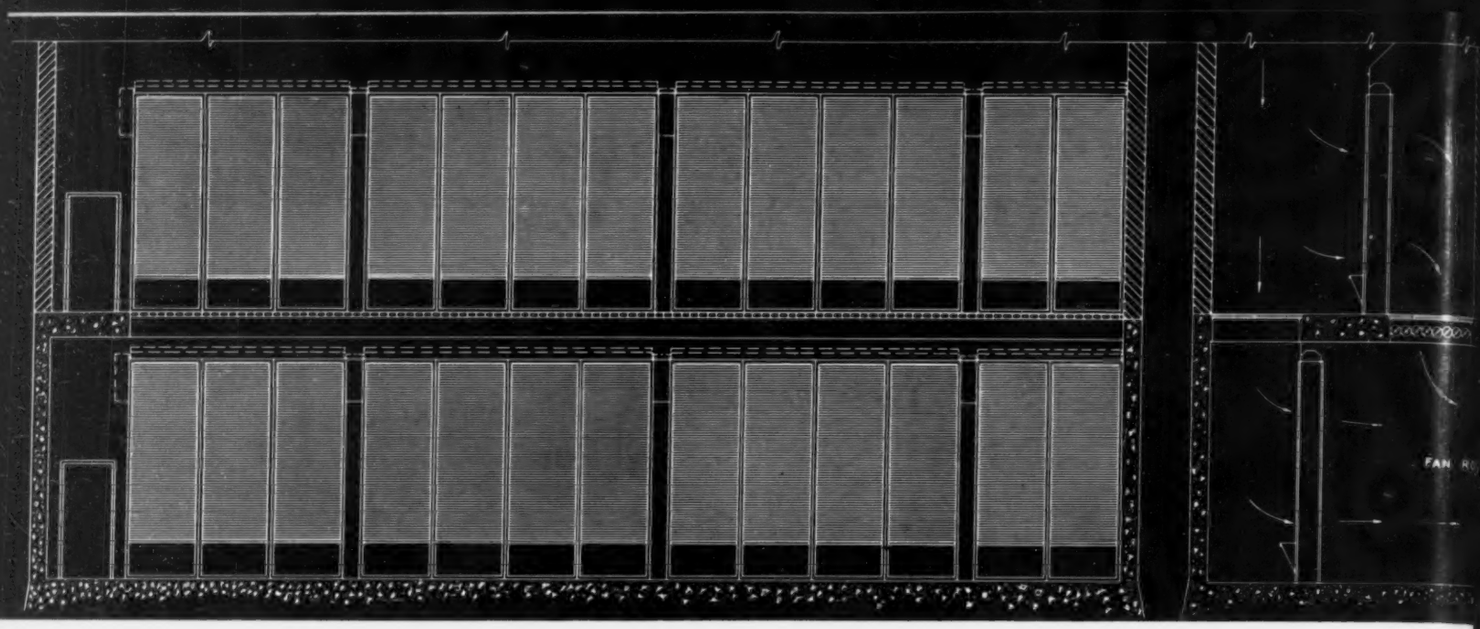
NATIONAL CARBON COMPANY, INC.

Unit of Union Carbide UCC and Carbon Corporation

CARBON SALES DIVISION, CLEVELAND, OHIO

General Offices: 30 East 42nd Street, New York, N. Y.

Branch Sales Offices: New York Pittsburgh Chicago San Francisco



Another large *Multi-Panel* FILTER AT HOMESTEAD

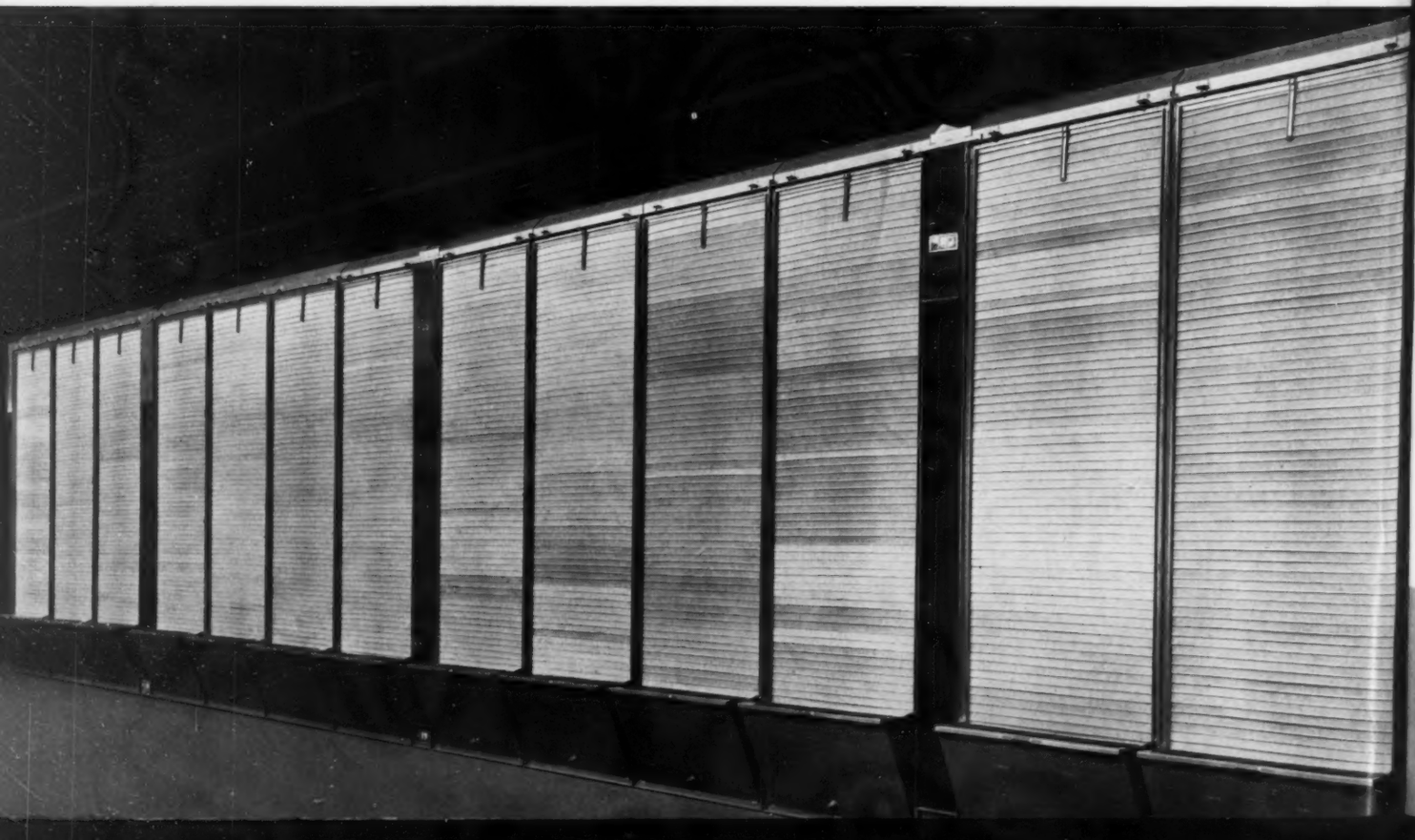
This five hundred thousand CFM American Multi-Panel Air Filter for the 100" semi-continuous plate mill—One of three large AAF installations at Homestead—Consists of twenty-six standard sections thirteen feet high, arranged in two tiers as shown in drawing above.

The photograph below shows one tier of thirteen sections completely assembled for testing at factory before shipment.

Multi-Panel is now used in 95% of all steel mills having ma drive motors. Multi-Panel was developed in 1928 to meet st mill requirements and has since become ***standard*** for m motor protection.

Send for "American Air Filters in Industry" which gives d tailed information on the savings that American Multi-Pa filters have effected for the largest companies in the ir and steel indstry.

AMERICAN AIR FILTER CO., INC. 334 CENTRAL AVENUE **LOUISVILLE, KENTUCK**



Continuous, Low-Cost Crane Service is the **Tiger's** *task in steel mills*

WHITING Tiger CRANE

In this new plate mill they have two Tiger cranes, 78'8" span, equipped with lifting magnet for handling slabs to the reheating furnaces.

As in other steel-mill installations, these Tiger Cranes are doing a fine job. Tiger Cranes, like our modern streamline trains, are specially designed to eliminate weight without sacrificing strength, and the result is a more speedy, economical crane — the kind of crane a steel mill can depend on to operate all the time without shutdowns, with less power consumption and a minimum of maintenance expense.

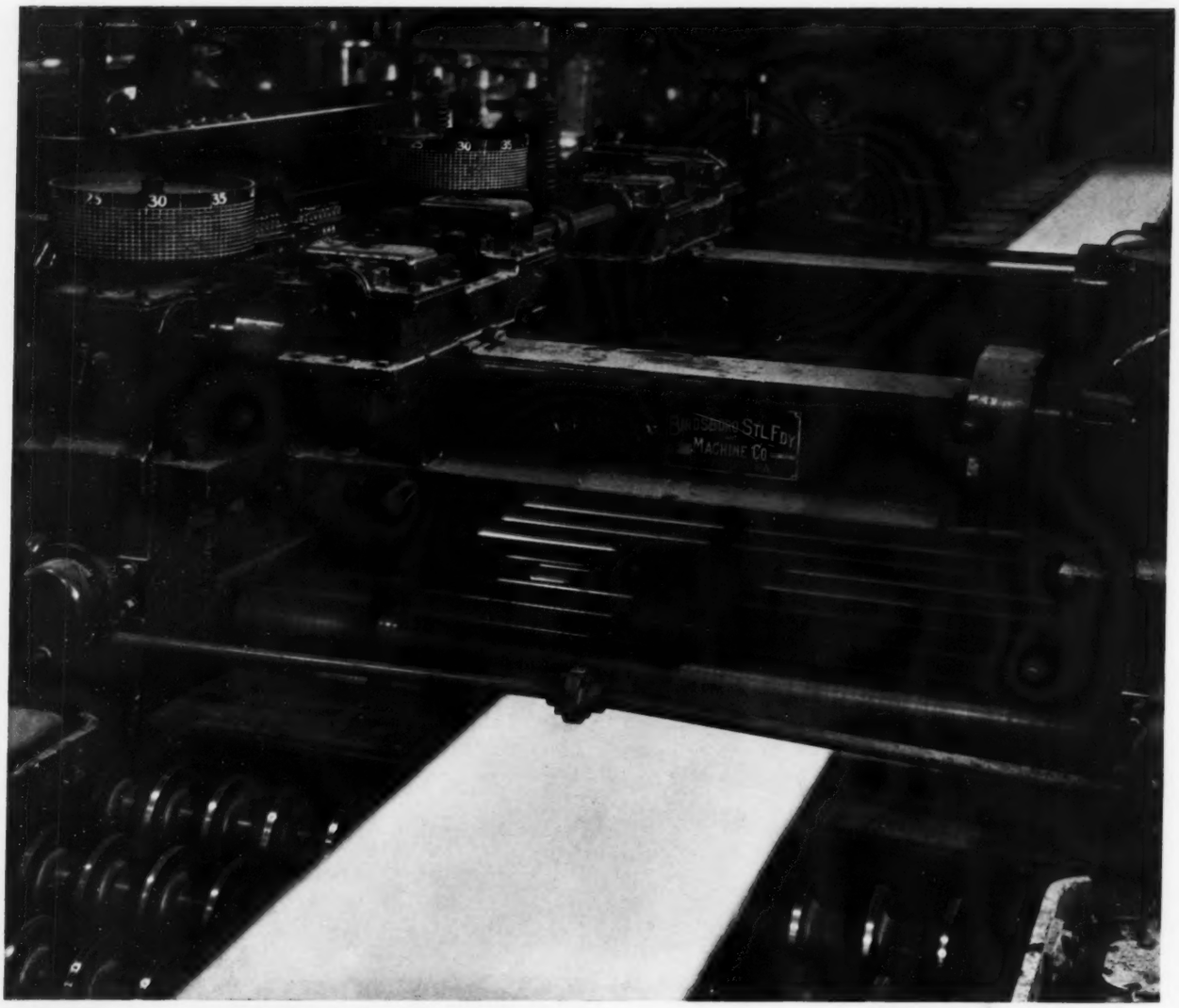
Tiger Bulletin No. 300 on request

WHITING CORPORATION, 15655 LATHROP AVE., HARVEY, ILL.

Electric Traveling Cranes
Foundry Equipment
Railroad Equipment
Pulverized Coal Machinery
Stokers—Special Machinery

WHITING

PIONEERS SINCE 1884



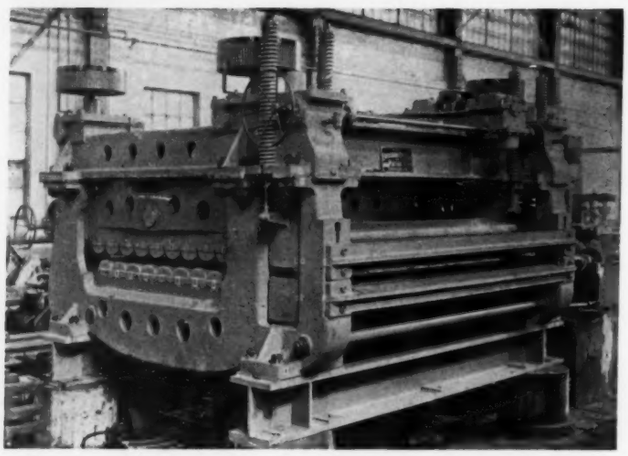


Plate leveler on the new 100" plate mill recently built in the Pittsburgh district.

Left—Shop view of the same leveler.

BIRDSBORO

PLATE LEVELER FOR PLATES UP TO 100" WIDE

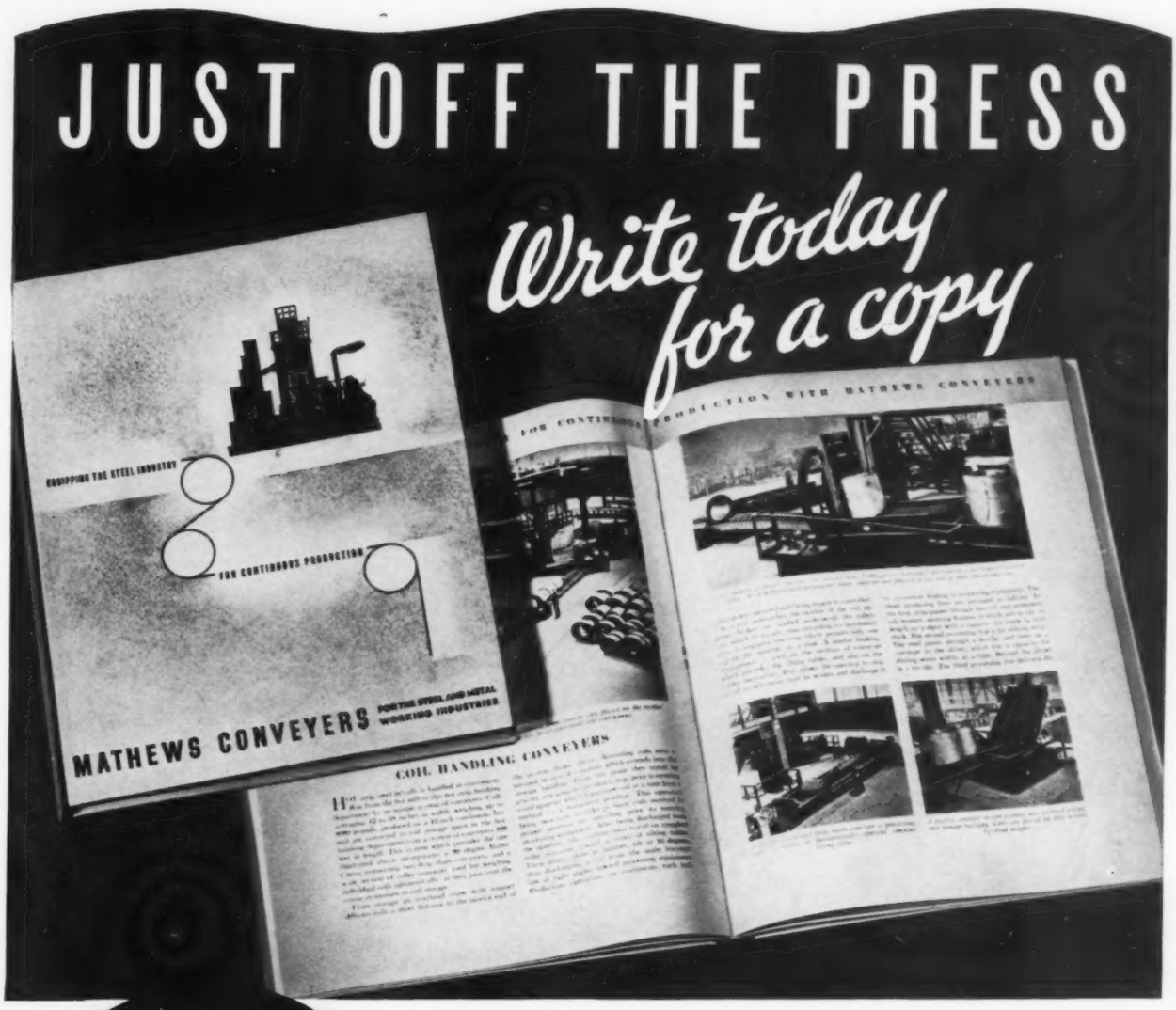
BIRDSBORO STEEL FOUNDRY & MACHINE CO.

BIRDSBORO, PA.

DESIGNERS and BUILDERS of ROLLING MILLS and AUXILIARY EQUIPMENT

JUST OFF THE PRESS

Write today for a copy



THIS NEW BOOK IS FREE TO EXECUTIVES IN THE IRON AND STEEL INDUSTRY

Here is the latest and most complete showing of modern materials handling systems in the Steel Industry. It is a summary of processing equipment furnished by Mathews during the past eighteen months for America's largest mills.

Over one hundred pages, fully illustrated and written for both Operating and Engineering Executives.

This new book is not just another catalog, but shows how the most advanced Mills are applying the Continuous Flow Principle of Handling Materials, especially in processing departments, to attain maximum output, unite operations, and cut obstinate costs. Executives of the industry are invited to write for a copy, without obligation.

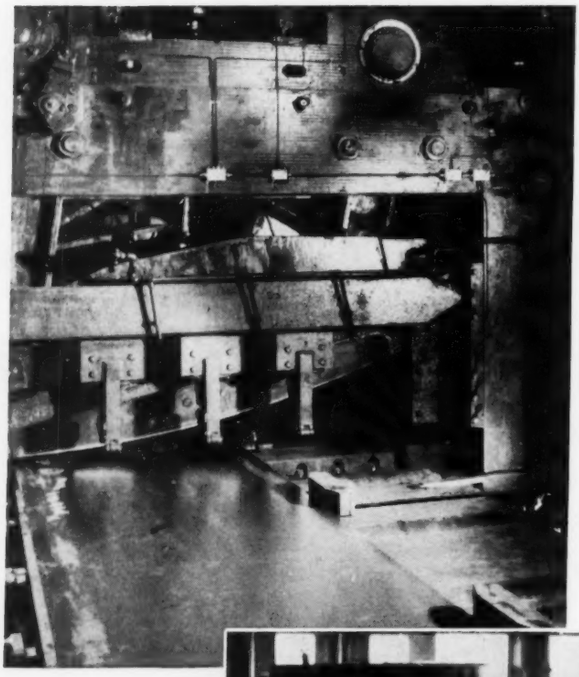
MATHEWS CONVEYER CO., 144 TENTH ST., ELLWOOD CITY, PENNA.

MATHEWS

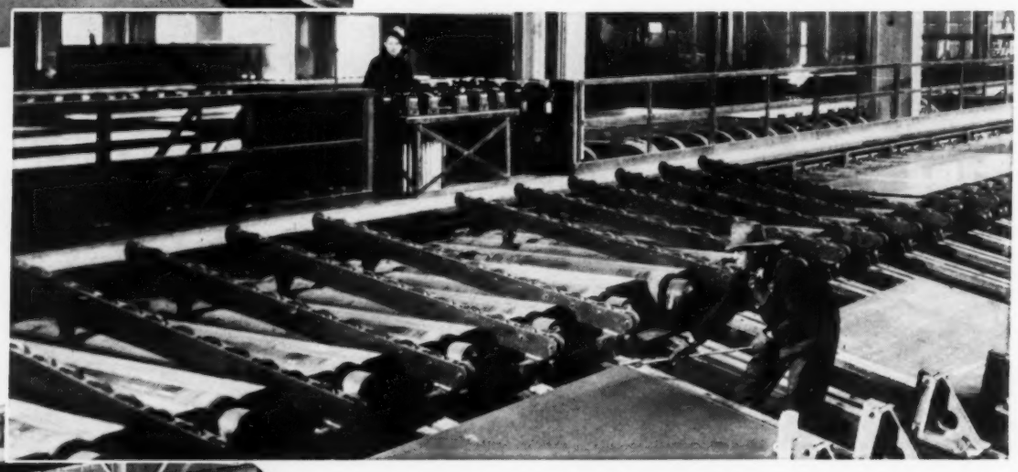
CONTINUOUS FLOW PRINCIPLE OF HANDLING MATERIALS

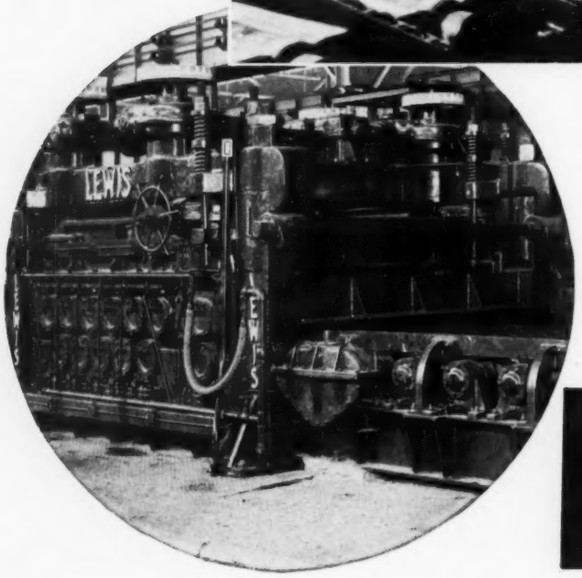
CONVEYERS

Where *Wear* is a problem...



• Hyatt Roller Bearings are designed and built to withstand the strains of punishing speeds and loads, to preserve the original accuracy of the related parts they serve. Wear and its resultant difficulties are reduced to a minimum by these better bearings. Thus, to all mechanical equipment in the mill, new or change-over, Hyatts contribute permanent bearing satisfaction, long life, and maintenance economies. Hyatt Bearings Division, General Motors Corporation, Newark, Detroit, San Francisco. Hyatt Roller Bearing Sales Company, Chicago and Pittsburgh.

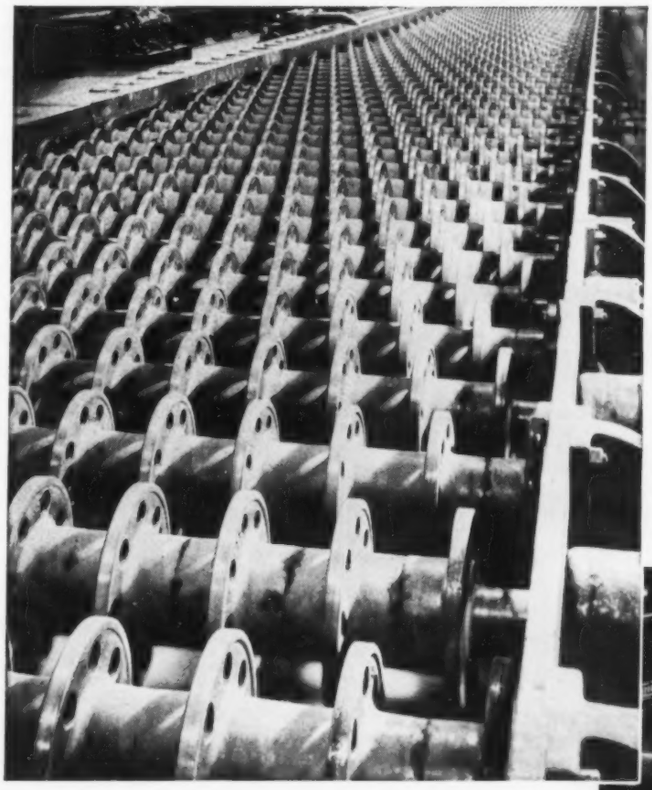


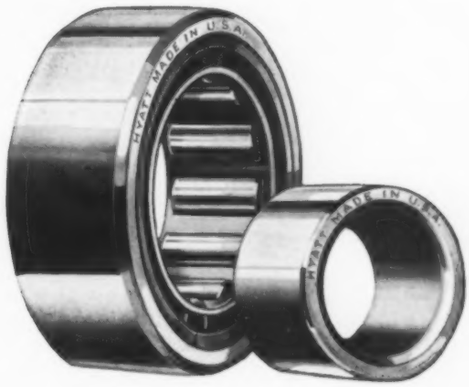


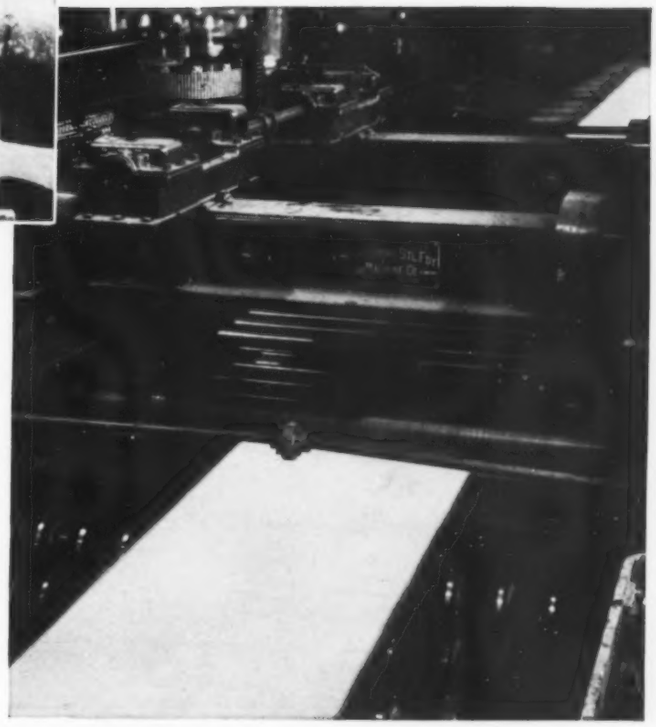
Builders of all types of steel mill equipment are tooled up for Hyatts. No matter what new equipment you may be contemplating or whatever change-overs you may have under way, Hyatt Roller Bearings are available—also the services of Hyatt Engineers.

HYATT

the answer is sturdy HYATTS







The equipment illustrated comprises but part of the many Hyatt applications in a recently completed plate mill in the Pittsburgh district. Here, as in many mills throughout the country, Hyatt Roller Bearings are serving and saving in tables, cranes, motors, cars, and auxiliary equipment.

Hyattized equipment illustrated includes stacking beds, approach tables, Soderberg Shear, Lewis and Birdsboro Levelers.

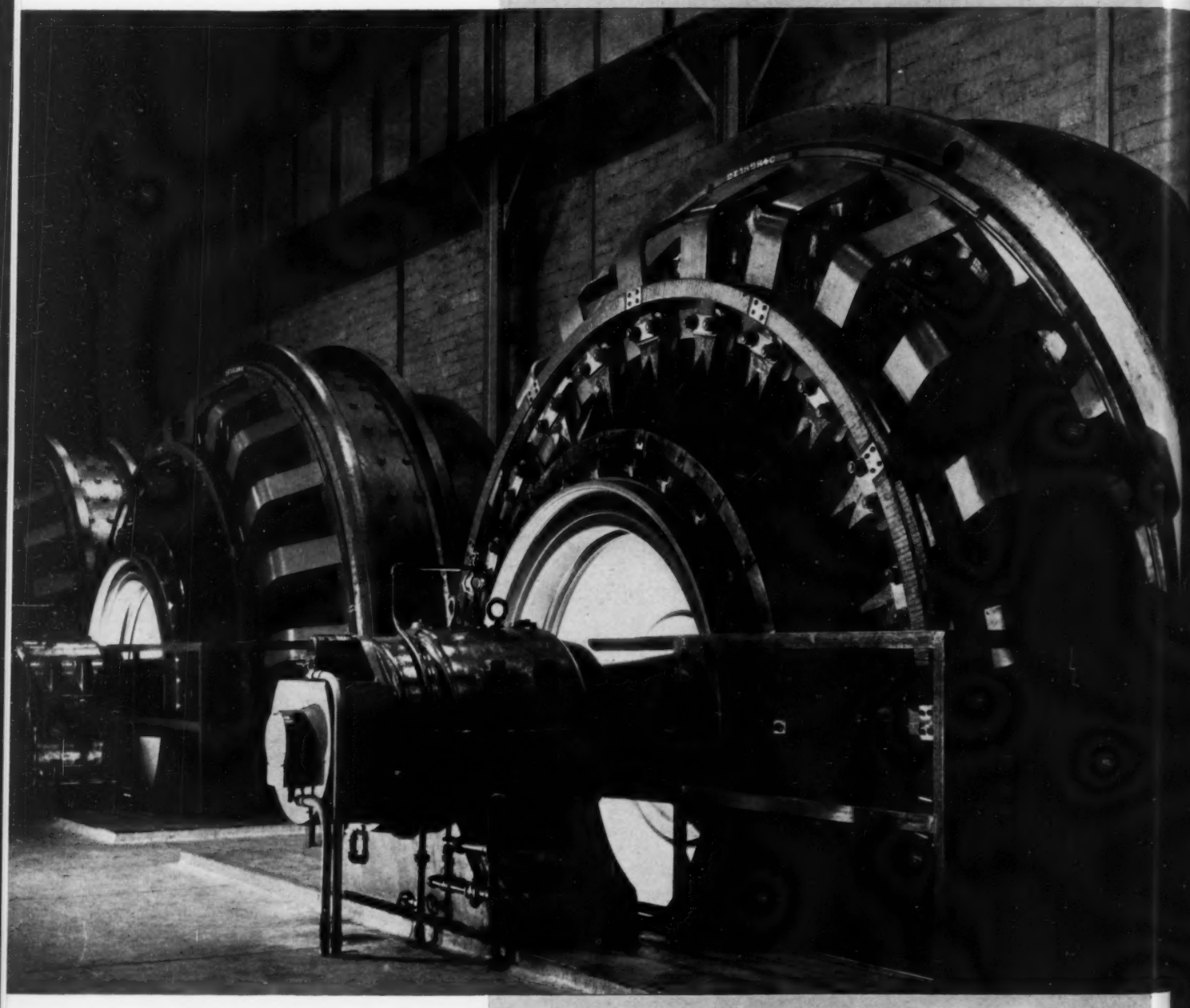
Roller Bearings

• MODERN
• CONTINUOUS
• DEPENDABLE

Over many years Allis-Chalmers motors have established an enviable reputation for rugged, reliable service in many outstanding installations.

Large d-c motors, such as the 5000 hp main roll drive motors shown below, have armatures with "Frog-Leg" windings. These give 100% cross-connection without the use of separate cross connectors. They give better commutation at all loads.

"Frog-Leg" windings and other important features of the large d-c motors, together with many installation and shop illustrations are shown in a new bulletin, 1157. Write for your copy.



★ **Other Allis-Chalmers products for the steel mill include, motor-generator sets, control, switchboards, mercury arc power rectifiers, transformers, blast furnace blowers, compressors and centrifugal descaling pumps.**

EQUIPMENT ENGINEERS TO INDUSTRY

ALLIS • CHALMERS

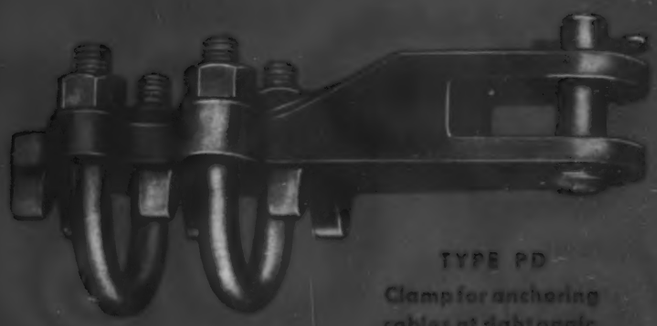
MILWAUKEE WISCONSIN

THE HOMESTEAD 100" SEMI-CONTINUOUS PLATE MILL

uses...

KEYSTONE
Contact Rail Material and Clamps

When you visit the Homestead Works see these Keystone Products in use



TYPE PD
Clamp for anchoring cables at right angle turns or dead ends

TYPE DDI
Contact Rail Insulator for 16 lb. rail

TYPE HA
Contact Rail Insulator for 40 lb. rail

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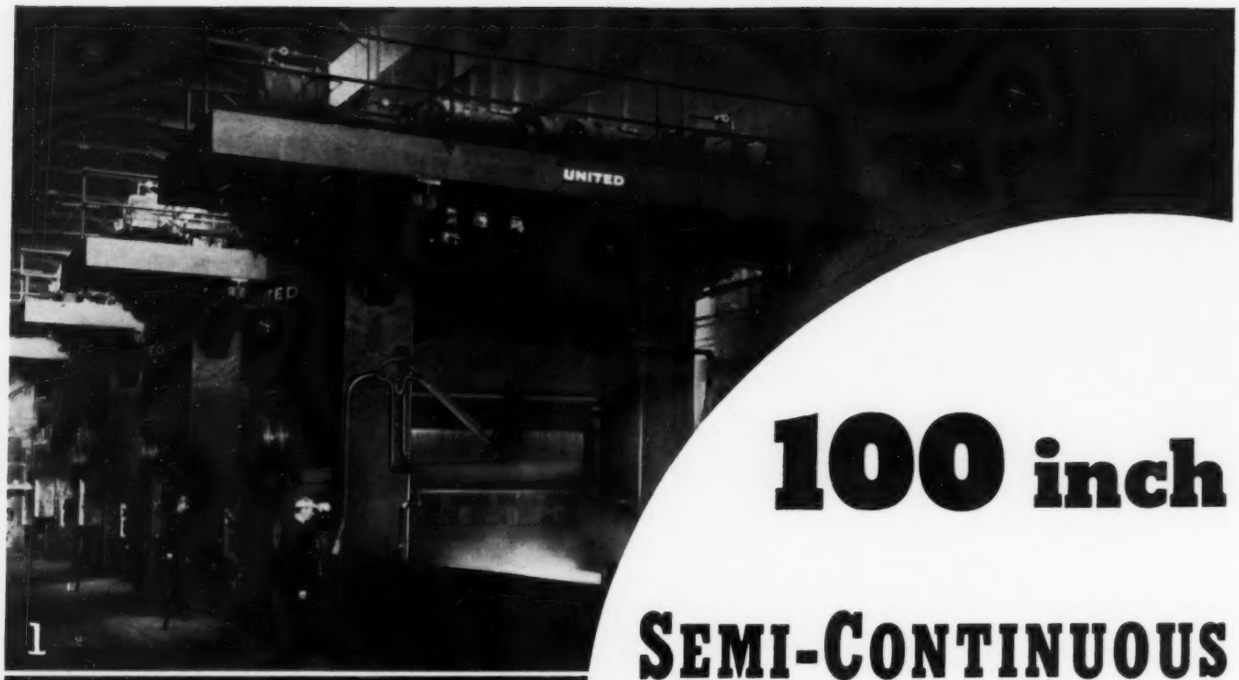
Refer to our Catalog No. 10 and Supplement

Write for new supplement



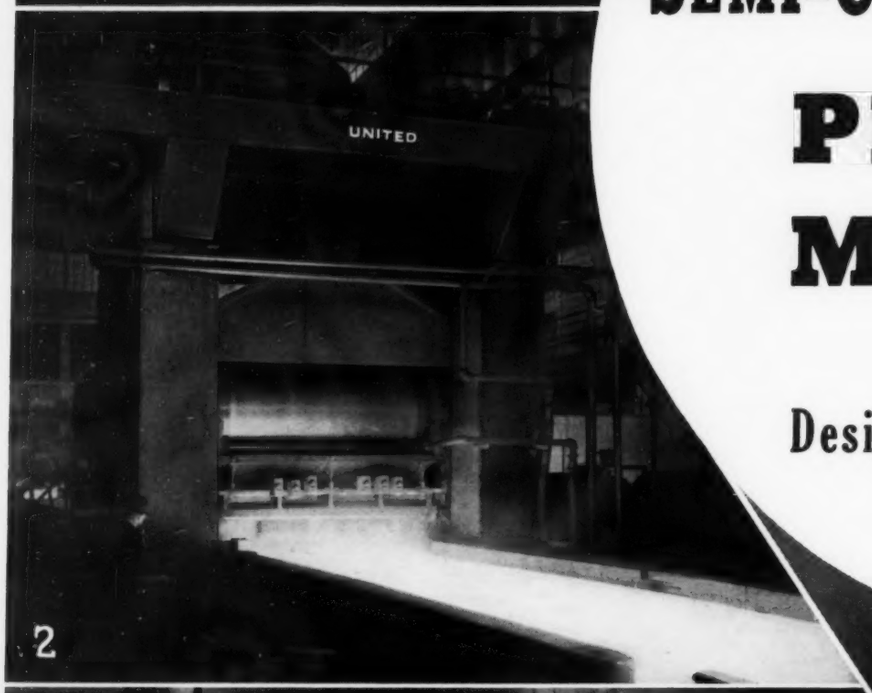
1

100 inch

SEMI-CONTINUOUS

PLATE MILL

Designed and Built By



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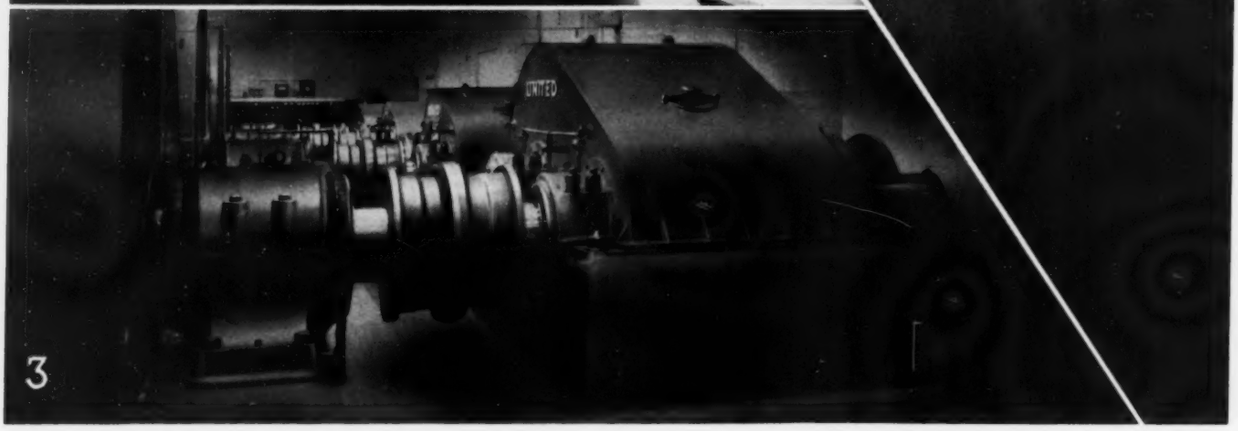

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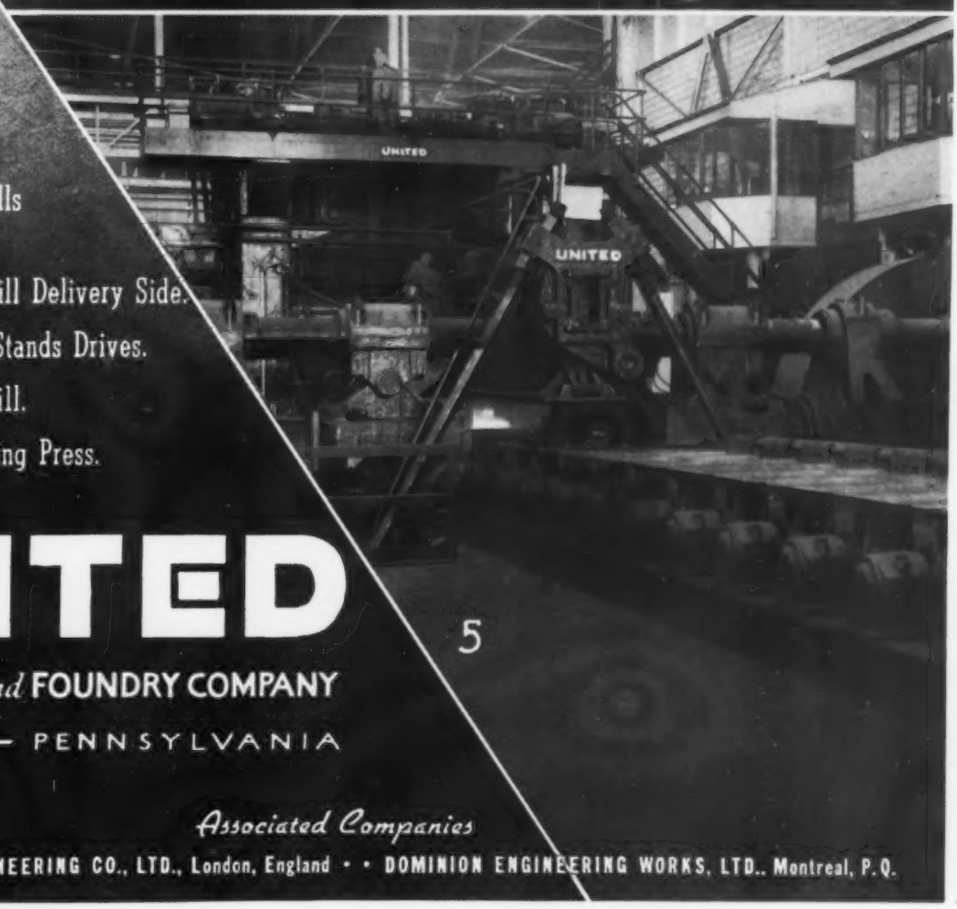

1. 4-High Finishing Mills Delivery End.
2. 4-High Reversing Mill Delivery Side.
3. 5000 hp Finishing Stands Drives.
4. 4-High Reversing Mill.
5. Horizontal Slab Edging Press.

UNITED

ENGINEERING *and* FOUNDRY COMPANY

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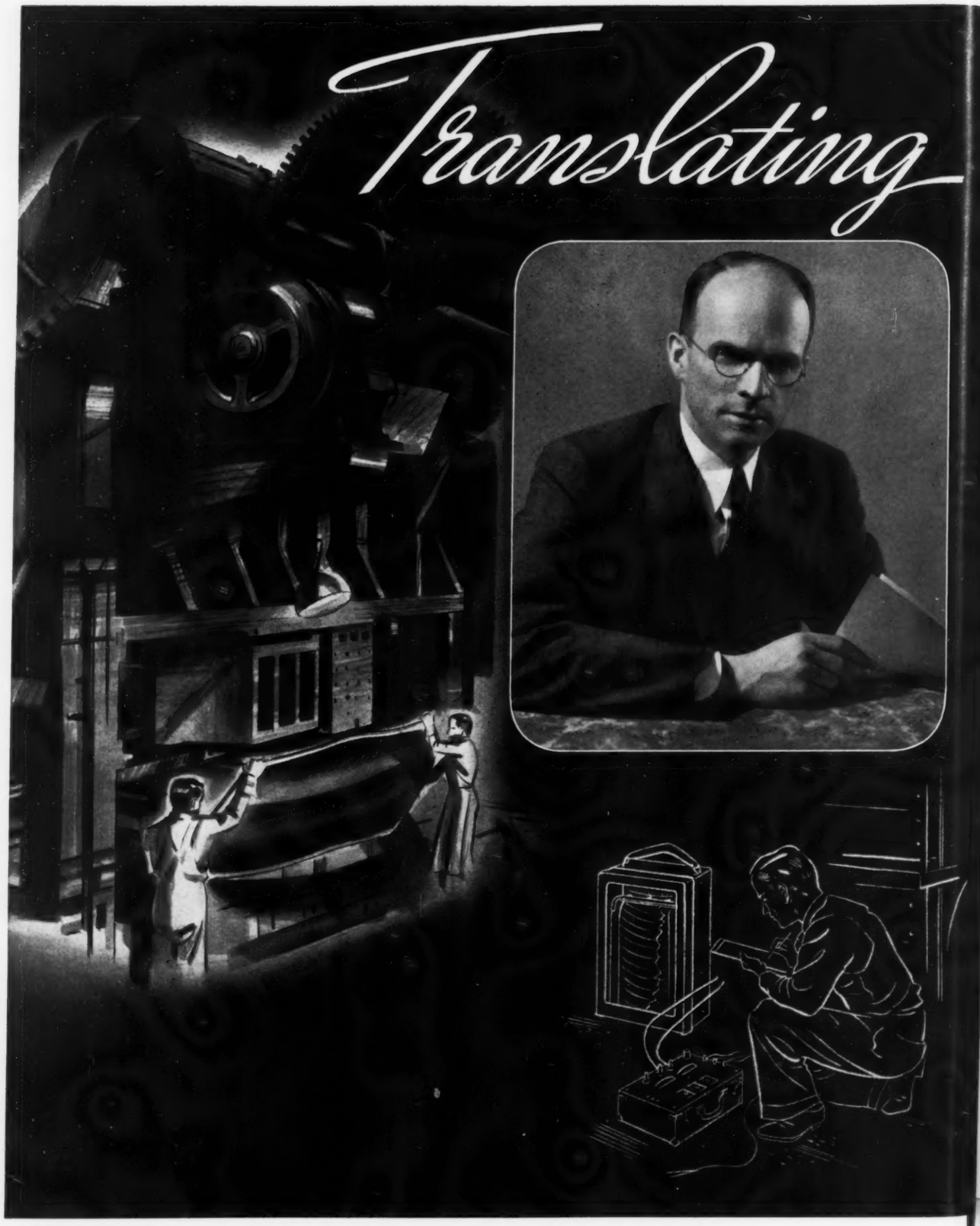
Associated Companies

DAVY and UNITED ENGINEERING CO., LTD., London, England • • DOMINION ENGINEERING WORKS, LTD., Montreal, P.Q.



R. H. Smith's motto is, "We may not know all the answers, but we have lots of confidence in our ability to find one for you." "Let's see what we can do together," is his attitude in approaching an application job.

MOTOR-DRIVE INTO PRODUCTION . .

When you say, "Here's what we want to do. Can you work out a motor-drive to do the trick?" we know there's something more than power involved. We go at the job with an eye on production « « « Our experience often yields parallel cases. A situation studied last week may resemble yours so closely that with modifications we can adapt the results to your job. A mixing and stirring of your ideas with ours brings the answer « « « Our label on such work is "Application Engineering." Its purpose is to make *Reliance* stand for more than just "motors." We are constantly studying machines and production processes, digging up ways to do things better or faster with motor-drive. Findings are assembled in engineering manuals maintained at our district offices. With them go suggestions as to where and how these new ideas can be put to profitable use. Experienced engineers in our offices pass them along to you.

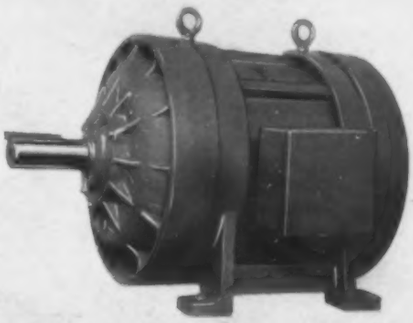
—Roscoe H. Smith

In charge of Application Engineering

Continuous processing of materials calls for novel electrical developments to meet unusual conditions peculiar to each job. An example is the Wean Continuous Pickle Line. Here coils of sheet strip steel are unwound, sheared, stitched to end of preceding strip, passed through acid tanks, cold-water tanks, hot-water tanks and finally recoiled. Motors must be applied for the separate operations and all units synchronized . . . The view at the right shows entrance end of pickle line with d-c. motors on un-coiler and stitcher pinch rolls; a-c. motors on up-cut shear and stitcher. For these lines Reliance developed direct-current fan-cooled motors larger than any ever built. Quick-acting, low inertia squirrel-cage a-c. motors were used for the first time on shears and slitters. Special tension devices were installed to insure the winding of tight coils . . . You are invited to make use of our experience in such work.

RELIANCE ELECTRIC AND ENGINEERING COMPANY
1088 IVANHOE ROAD • CLEVELAND, OHIO
Branches: BIRMINGHAM • BOSTON • BUFFALO • CHICAGO • CINCINNATI
DETROIT • GREENVILLE, S. C. • NEW YORK • PHILADELPHIA • PITTSBURGH
Representatives in Other Principal Cities

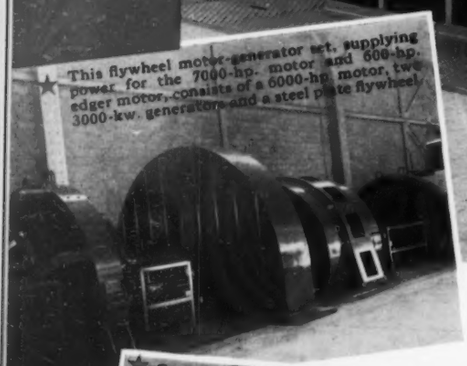
Entrance End of Continuous Pickling Line for Sheet-strip Steel.



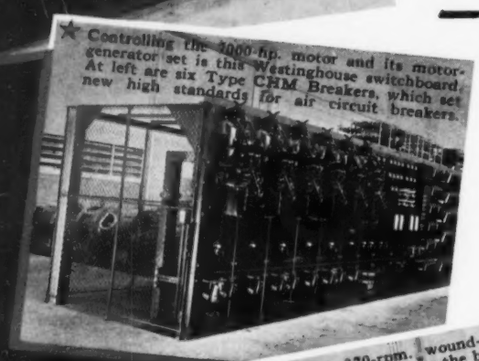
Enclosed Squirrel-cage Motor as used on Up-cut Shear.

RELIANCE A-C D-C **MOTORS**

AGAIN IN 1937



★ This flywheel motor-generator set, supplying power for the 7000-hp. motor and 600-hp. edger motor, consists of a 6000-hp. motor, two 3000-kw. generators and a steel plate flywheel.



★ Controlling the 7000-hp. motor and its motor-generator set is this Westinghouse switchboard. At left are six Type CHM Breakers, which set new high standards for air circuit breakers.

★ Westinghouse 4500-hp., 370-rpm., wound-rotor motor, which drives the broad-side stand at Homestead.

★ This 7000-hp. 40/80-rpm. Westinghouse motor drives the reversing rougher of Homestead's new 100-inch plate mill.

— It's WESTINGHOUSE *at Homestead*

In 1926, Westinghouse supplied a major part of the electrical equipment for structural mills at Homestead. Now, in 1937, Westinghouse again plays a prominent part at Homestead — for Carnegie-Illinois' new 100-inch plate mill put in operation early this year.

For the reversing rougher of this mill, Westinghouse supplied one of the most powerful single-armature motors ever built—delivering 2,500,000 pounds-feet torque at 37 rpm. Motor-generator and control for this motor were also supplied by Westinghouse, as well as a 600-hp., 125/406 rpm. motor driving the edging rolls for this stand. Other Westinghouse equipment included a 4500-hp., 370-rpm. motor, with slip regulator, driving the broadside stand.

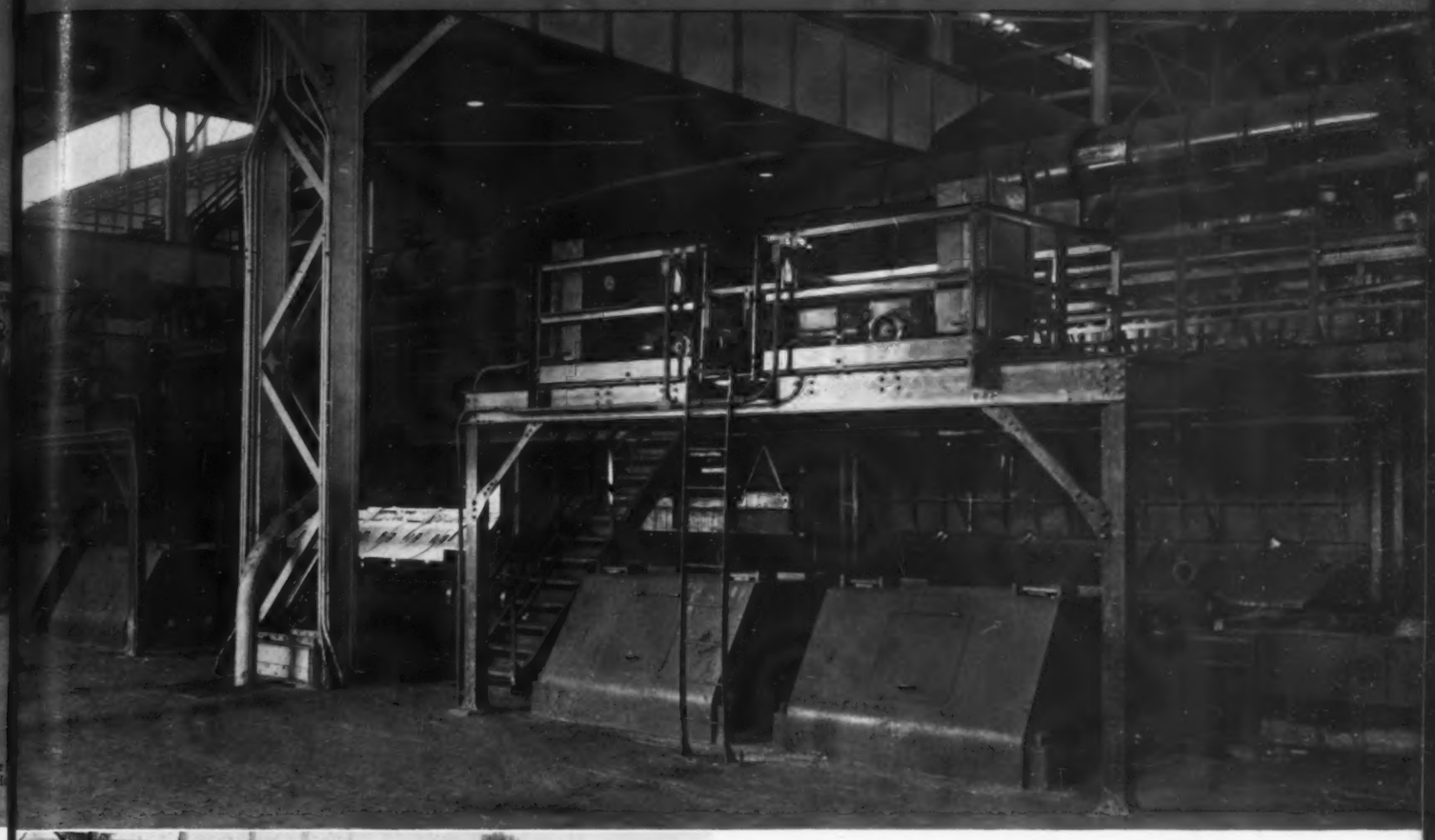
There is no steel mill electrical problem that cannot be met with the wide range of Westinghouse equipment, or by the ingenuity of Westinghouse steel mill engineers. Their assistance is at your disposal at all times. Call your nearest district office. J 932

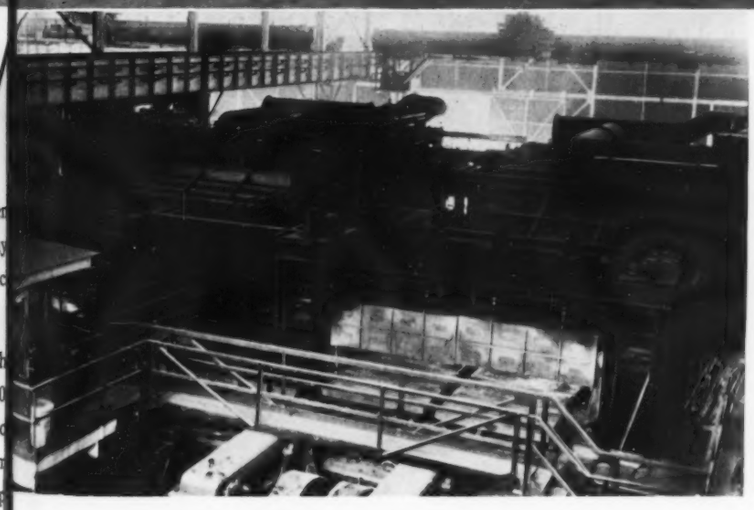
Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.

UNDIVIDED RESPONSIBILITY MULTIPLIES THE VALUE of WESTINGHOUSE SERVICE

FROM POWER SUPPLY TO DRIVEN MACHINE..

Specify **Westinghouse**





(Top) Front view of slab reheating furnaces installed at the recently completed plate mill in the Pittsburgh district.

(Below) Rear view of the same installation.

ANOTHER INSTALLATION

By RUST

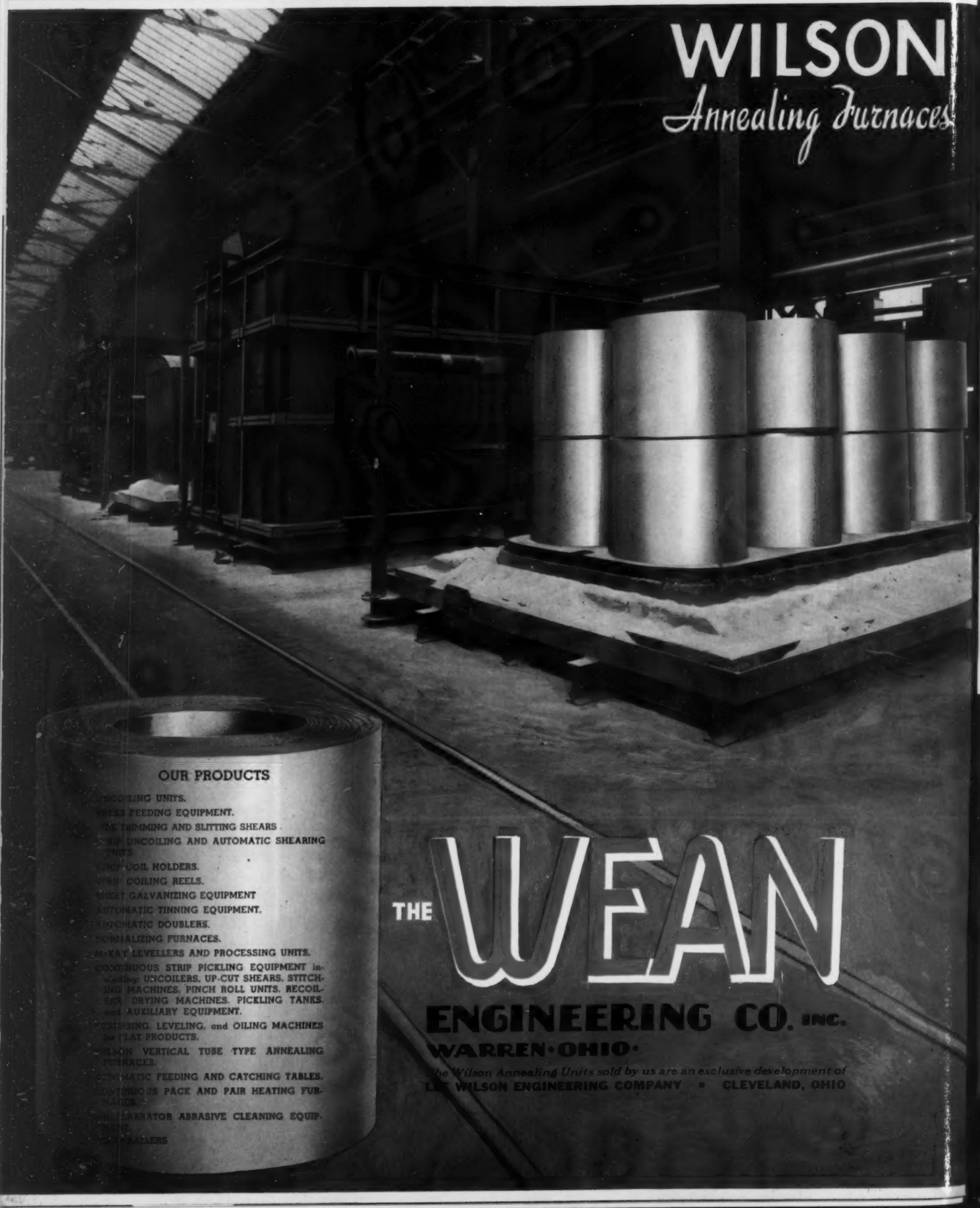
....the slab heating furnaces for the recently completed plate mill in the Pittsburgh district.

Each of the three furnaces is designed for reheating 50 gross tons of cold slabs per hour. Correct design and economy of operation link these furnaces with the long list of many other succesful installations engineered and built by Rust for the Steel Industry.

Rust Furnace Company

PITTSBURGH, PA.

Better Strip Annealing with -


WILSON
Annealing Furnaces
OUR PRODUCTS
UNCOILING UNITS.
STRIP FEEDING EQUIPMENT.
EDGE TRIMMING AND SLITTING SHEARS.
STRIP UNCOILING AND AUTOMATIC SHEARING UNITS.
STRIP COIL HOLDERS.
STRIP COILING REELS.
STRIP GALVANIZING EQUIPMENT
AUTOMATIC TINNING EQUIPMENT.
AUTOMATIC DOUBLERS.
NORMALIZING FURNACES.
MI-KAY LEVELLERS AND PROCESSING UNITS.
CONTINUOUS STRIP PICKLING EQUIPMENT including UNCOILERS, UP-CUT SHEARS, STITCHING MACHINES, PINCH ROLL UNITS, RECOILERS, DRYING MACHINES, PICKLING TANKS, and AUXILIARY EQUIPMENT.
CROPPING, LEVELING, and OILING MACHINES for FLAT PRODUCTS.
WILSON VERTICAL TUBE TYPE ANNEALING FURNACES.
AUTOMATIC FEEDING AND CATCHING TABLES.
CONTINUOUS PACK AND PAIR HEATING FURNACES.
VIBRATOR ABRASIVE CLEANING EQUIPMENT
STRIP LEVELLERS
THE WEAN
ENGINEERING CO. INC.
WARREN·OHIO·
The Wilson Annealing Units sold by us are an exclusive development of
LEE WILSON ENGINEERING COMPANY • CLEVELAND, OHIO

AMERICAN IRON & STEEL INSTITUTE ELECTS OFFICERS

TOM M. GIRDLER, Elected President,
ERNEST T. WEIR, Vice President

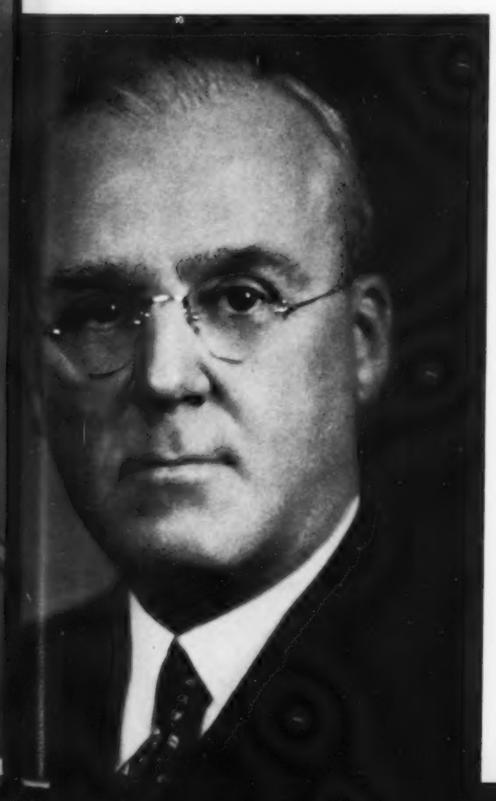
Tom M. Girdler, chairman of Republic Steel Corporation, was recently elected to the presidency of the American Iron and Steel Institute. An Indiana farm boy, he has been in steel since obtaining a job as a mill hand with the Oliver Iron and Steel Company in 1900.

Mr. Girdler was graduated from Lehigh University in 1900 as a mechanical engineer. For the next 14 years he worked successively for Oliver Iron and Steel, Buffalo Forge, Colorado Fuel and Iron, and Atlanta Steel. In 1914 he was hired as assistant to the general superintendent of Jones & Laughlins' Aliquippa plant. From here he rose to be general superintendent and then president of the company.

In 1930 Mr. Girdler left Jones & Laughlin to head the newly organized Republic Steel Corporation.

Ernest Tener Weir was born in Pittsburgh, Pennsylvania, and attended Pittsburgh public schools until he was fifteen, when he entered the employ of the Braddock Wire Company of Pittsburgh, transferring a year later to the Oliver Wire Company of that city. In 1901 he was appointed manager of the Monongahela tin plate mills of the American Tin Plate Company, and two years later was placed in charge of the company's mills at Monessen, Pennsylvania. He was one of the organizers of the Phillips Sheet and Tin Plate Company, incorporated in 1905 with Mr. J. R. Phillips being president and Mr. Weir, secretary and general manager. Mr. Weir succeeded Mr. Phillips upon his death, and gradually increased the number of plants. In 1918, the firm was reorganized as the Weirton Steel Company.

In 1928, Mr. Weir initiated the steps which culminated in the formation of the National Steel Corporation. This was accomplished by merger of the Weirton Steel Company with the Great Lakes Steel Corporation of Detroit, Michigan, the Hanna Iron Ore Company of Cleveland, Ohio, the Hanna Furnace Corporation of Buffalo, New York, and several other smaller organizations.



E. T. WEIR
Chairman of Board
NATIONAL STEEL CORP.

TOM M. GIRDLER
Chairman of Board
REPUBLIC STEEL CORP.

ITEMS OF INTEREST

R. L. Leventry has been named district manager of the Youngstown district of Republic Steel Corporation. Mr. Leventry, a native of Johnstown, Pennsylvania, has been associated with Republic for the past 19 years, prior to which he attended Cornell University and worked at a great variety of mill jobs with the Cambria Steel Company (now Bethlehem Steel Company), where he was assistant superintendent of open hearths in 1917 and 1918. Coming to Republic as superintendent of open hearths at Youngstown in 1918, he was also placed in charge of the mills three months later. In 1927 Mr. Leventry was named assistant district manager and he continued in that capacity until 1935, when he became general superintendent.

▲

B. W. Norton, formerly superintendent of blast furnaces and coke plant, of the Republic Steel Corporation, Youngstown, Ohio, has been appointed as assistant district manager of the Youngstown district. Mr. Norton is a native of Wilkinsburg, Pennsylvania, and has been with Republic and its predecessors in the coke plant and blast furnaces since 1925, when he was graduated from Pennsylvania State College as a metallurgical engineer.

▲

F. C. Farrell has been appointed assistant district manager to Frank E. Flynn, district manager of the Warren district, Republic Steel Corporation. Mr. Farrell has been in the industry since 1905 and has had a wide range of experience in steel making operations throughout the Youngstown-Warren sector.

▲

Thomas A. Johnston has been appointed metallurgist at the Farrell-Mercer Works of the Carnegie-Illinois Steel Corporation. This appointment is effective immediately.

Mr. Johnston was formerly head of the plant's sheet and tin mill laboratory. An employee of United States Steel Corporation subsidiaries since 1904, his first job was as a shear boy in the Farrell tin mills.

▲

William A. Marshall was appointed superintendent of construction of the Irvin Works, Carnegie-Illinois Steel Corporation.

A graduate of the Pennsylvania State College, Mr. Marshall was resident engineer at Vandergrift Works from March, 1935 until his promotion. Prior to that time he was successively assistant master mechanic and master mechanic at Farrell Works, and from August 1, 1932 to February 28, 1935 master mechanic at Farrell-Mercer Works.

▲

George M. Croft was appointed superintendent of plant maintenance at the Vandergrift Works of the Carnegie-Illinois Steel Corporation. Mr. Croft was formerly blooming and bar mill superintendent at this plant.

▲

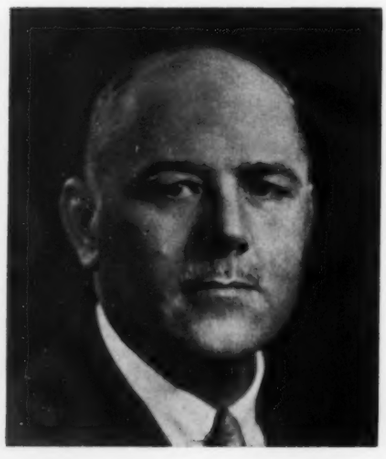
James M. Bortz has been promoted to superintendent of blooming and bar mill at the Vandergrift Works of the Carnegie-Illinois Steel Corporation. Mr. Bortz, formerly, was assistant resident engineer.

▲

Walter E. Camp, as announced by the Carnegie-Illinois Steel Corporation, has been appointed assistant to the manager of public relations, Pittsburgh district.

A graduate of Washington and Jefferson College, class of 1932, Camp was employed by Carnegie Steel Company in January, 1934, and for two years was employee news editor at Clairton Works.

R. L. LEVENTRY



B. W. NORTON

F. C. FARRELL

WALTER E. CAMP

S. M. D. CLAPPER

FLOYD L. GREENE

John E. McGrath, a University of Pittsburgh graduate, has been appointed as Camp's successor at Clairton, effective May 1.

▲

S. M. D. Clapper, who has been actively engaged in the management of General Refractories Company since the early part of 1933, was recently elected chairman of its board of directors, to continue the management of its affairs of policy.

Mr. Clapper is also chairman of the board of directors of Schlichter Jute Cordage Company, Philadelphia; a director of Central Penn National Bank; Fire Association of Philadelphia; Guaranty Company of North America; ;Reliance Insurance Company of Philadelphia; and Delaware County National Bank of Chester, Pa., vice president, resident in Philadelphia, of Cannon Mills, Inc. and treasurer of Ewing Thomas Corporation, Chester, Pa.

Mr. Clapper was active in the organization of the Mortgage Service Company of Philadelphia, formed to protect the interests of holders of bonds guaranteed by Philadelphia Company, and to liquidate the affairs of that company, and was chairman of the general committee for protection of Bondholders.

▲

Floyd L. Greene, who has recently been elected president of the General Refractories Company, has been actively identified with the refractories industry for twenty-five years.;

He was general superintendent of the Standard Refractories Company at the time of its acquisition by General Refractories Company in 1922, becoming successively district manager of Central Pennsylvania operations, general works manager, vice president in charge of operations, executive vice president and president. He has been a director of the company for many years.

Mr. Greene is also a director of several of the subsidiaries of the parent;company, a director and member of the executive committee of the American Refractories Institute, and vice president and a director of the First National Bank of Claysburg, Penna.

A. L. Sonnhalter has been named president of Pittsburgh Crucible Steel Co., succeeding F. B. Hufnagel, who continues as chairman and president of Crucible Steel Co. of America, the parent company.

Mr. Sonnhalter previously was vice president in charge of production. His successor has not yet been appointed. He will maintain headquarters at Pittsburgh.

▲

C. C. Caudill, for 12 years general manager of the Portsmouth, O., works of the Wheeling Steel Corp., Wheeling, W. Va., was transferred to the Wheeling works, effective June 1. George W. Moore, of Portsmouth, will succeed Mr. Caudill.

▲

H. O. K. Meister has been appointed general manager of the Hyatt Bearings Division, General Motors Corporation, Harrison, New Jersey, succeeding the late general manager, H. J. Forsythe.

Mr. Meister has been employed in various capacities in the Hyatt Division since 1914. In that year he joined the Hyatt Roller Bearing Company, the predecessor of the Hyatt Division, as assistant advertising manager in Harrison. Later he was transferred to Chicago in the sales department of the Hyatt tractor and implement bearings division and in 1920 became sales manager of that unit.

In 1925 Mr. Meister returned to Harrison as general sales manager of the entire Hyatt Division and in 1929 was named assistant general manager, in which capacity he served until his appointment as general manager.

Mr. Meister was born in Milwaukee 49 years ago, educated in the Milwaukee public schools and studied in the extension department of the University of Wisconsin. Prior to Hyatt he was employed in the shops and engineering department of the Allis Chalmers Manufacturing Company.

▲

J. P. Boore has been appointed assistant general sales manager of The Babcock & Wilcox Tube Company, Beaver Falls, Pa. Mr. Boore has had broad

experience in the production and merchandising of seamless steel tubes and pipe. For several years he was vice president of Summerill Tubing Company and for twenty years prior to that he was associated with the Pittsburgh Steel Company in various capacities in the production and sales departments.

▲

E. J. Gove has been placed in charge of a new Cutler-Hammer office recently opened in Youngstown, Ohio.

Mr. Gove has been located in Youngstown for a number of years and the new office will give him

E. J. GOVE

headquarter facilities and provide better service for the company's customers in the Youngstown area.

The new office, which is a branch of Cutler-Hammer's Pittsburgh office, will be located at 1106 Central Tower.

▲

E. B. Evleth, formerly resident vice-president of the Minneapolis-Honeywell Regulator Company, Chicago, in charge of the Midwest region, has been appointed vice-president and general manager of the Brown Instrument Company, Philadelphia, a division of the Minneapolis-Honeywell company. He succeeds William J. Hajek, who retired on May 24 because of ill health. Mr. Evleth has been affiliated with the parent company for 12 years, starting as sales engineer. He attended the University of Minnesota. C. L. Saunders, former regional sales manager, has been appointed to succeed Mr. Evleth as resident vice president in Chicago.

▲

J. J. Summersby, assistant vice-president of the Worthington Pump & Machinery Corporation, Harrison, New Jersey, has been made general sales manager. He joined the company as a sales engineer immediately after his completion of post graduate work at Washington University in 1920 and has been continuously identified with the corporation since then as district sales manager, divisional sales manager and assistant general sales manager.

A. J. McCann has been appointed by the Otis Elevator Company to take over the sales activities in their Pittsburgh office, covering the blast furnace field, to succeed the late Mr. Frank Smith, to whom he was an assistant some years ago. Mr. McCann is thoroughly experienced in the problems connected with the blast furnace hoists and other equipment for steel mills made by that Company.

▲

Charles W. E. Clarke has rejoined the staff of United Engineers & Constructors Inc., as consulting engineer with headquarters at 1401 Arch Street, Philadelphia, Pennsylvania.

▲

C. Clarke Wales, chief engineer of Otis Steel Company, Cleveland, Ohio, and second vice-president of the Association of Iron and Steel Engineers, was among eight Cleveland men, prominent in national engineering and technical societies, honored at the annual meeting of the Cleveland Engineering society, June 8. Other men thus honored were: James M. Herron, president, James H. Herron Co., who is president of the American Society of Mechanical Engineers; R. C. Allen, vice president, Oglebay, Norton & Co., who is president of the American Institute of Mining and Metallurgical Engineers; A. M. MacCutcheon, vice president of Reliance Electric & Engineering Co., who is president of the American Institute of Electrical Engineers; Alfred E. Gibson, president of Wellman Engineering Company, who is president of the American Welding Society; Prof. Henry B. Dates, Case School of Applied Science, who is president of the Illuminating Engineers society; B. J. Schwendt, assistant signal engi-

C. CLARKE WALES

neer, New York Central Railroad, who is chairman of the signal section, Association of American Railroads; and, A. D. Taylor, president, American Association of Landscape Architects.

Take a Tip from "FLEETWELD ROD"

"USE ME WITH THE NEW 'SHIELD-ARC SAE' AND I'LL GIVE YOU 15% TO 20% FASTER WELDING"

"Here's Where I Get My Speed—Dual Continuous Control of the "SAE" gives me the right *type* of arc and the *exact welding current* for smoothest possible performance on every job. I spatter less and weld better.

"Here's Where I Get My Endurance—The "SAE" welder is self-protected against burnout so you can use me in my bigger sizes and get top speed *continuously.*

"That's how I'm *sprinting the marathon* these days—giving *'Shield-Arc SAE'* users 15% to 20% faster welding than they can get with 1937 model welders of conventional design.

"Yours for lower welding costs,
"FLEETWELD ROD"

—Spokesman for all progress-minded welding electrodes and emissary of

THE LINCOLN ELECTRIC COMPANY
Largest Manufacturers of Arc Welding Equipment in the World

THE LINCOLN ELECTRIC COMPANY
Dept. Z -399, Cleveland, Ohio

☐ My welding application is——
How can the "SAE" do it faster?
☐ Send a free copy of Bul. 412 giving details about the new *"Shield-Arc SAE"* welder.

Name _____ Position _____
Company _____
Address _____
City _____ State _____

LINCOLN "SHIELD-ARC SAE"

THE WELDER WITH DUAL *CONTINUOUS* CONTROL

J. J. Mortimer has been appointed superintendent of the blooming and plate mills at Gary Works of the Carnegie-Illinois Steel Corporation.

Mr. Mortimer has been at the corporation's South Works since 1905 and has served as superintendent of the 96-inch plate mill and the 44-inch slab mill since 1936.

J. J. MORTIMER

Beginning in 1905 at South Works, Mr. Mortimer worked in a number of positions until 1911 when he was appointed piler foreman of the universal mill. In 1917 he was made mill foreman at the same mill and a year later he became mill foreman of the No. 2 90-inch plate mill. After a brief term as shipper of the universal mill he was made assistant superintendent of that mill in 1919, a position he held until 1922 when he became assistant superintendent of the No. 1–90 and 132-inch plate mills and the No. 2–90-inch plate mill.

In 1930 he was made assistant superintendent of rolling mills and in 1933 he became superintendent of the universal mill, the 96-inch plate mill and the 44-inch slab mill.

▲

J. R. Luby, heretofore chief metallurgist of Follansbee Brothers Co., has been appointed metallurgist in charge of electrical sheet production of the Empire Sheet & Tin Plate Co., Mansfield, Ohio. Prior to becoming chief metallurgist for Follansbee, he was electrical sheet engineer for that company.

▲

W. C. Johnson has been placed in charge of the Knoxville, Tenn., office of the Allis-Chalmers Mfg. Co., Milwaukee. This office will operate as a branch of the company's Chattanooga district office, of which D. S. Kerr is manager.

▲

Malcolm F. McConnell, general superintendent of the Homestead Works of the Carnegie-Illinois Steel Corporation, received on June 9 the honorary degree of Doctor of Science from his alma mater, the University of Pittsburgh.

Mr. McConnell has been associated with subsidiaries of the United States Steel Corporation since he went to the New Castle Works in 1905 as a steam engineer.

He was born at New Castle, Pa., on November 3, 1880, received his grade and high school education there. He entered Pitt in 1886-87, remained three scholastic years, then was out until the school year 1901-02, when he was graduated with the degree of mechanical engineer.

For two years after leaving college he was with the LaBelle Iron Works, at Stuebenville, O., as a construction engineer.

In the following January, he entered the Carnegie Steel Company as a steam engineer, and worked in the New Castle Plant, the city office in Pittsburgh, and the Mingo and the former Bellaire Works in various official positions, including general superintendent at Mingo, until August 1, 1933, when he assumed the position he now holds at Homestead.

Died

W. E. Miller, electrical and mechanical superintendent, Bethlehem Steel Company, Johnstown, Penna., and past president of the Association of Iron and Steel Engineers, died in Johnstown, Monday, May 24th. Mr. Miller started to work at the Johnstown Plant in 1900 as an electrical repairman. In 1907 and until 1909 he was in charge of one of the earliest electrifications of iron ore mines in the Menominee Range at Vulcan, Michigan. In 1909, Mr. Miller was made construction foreman of the Electrical Department at the Cambria Works, which position he held until 1920, when he was made assistant superintendent of the electrical department. In 1925 he was appointed to the superintendency of this department and in late 1932 was placed in complete charge of both the electrical and mechanical operating departments for that plant.

W. E. MILLER